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On the Sulphurous Impurity in Coal Gas.

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[Read before the Royal Institution of Great Britain.]

The luminous flames we use to light our houses after sunset are all equally gas flames.

The gas which burns round the wick of a candle is formed by the action of heat on the grease of which the candle is made. The gas which burns over the wick of an oil lamp is formed by the action of heat on the oil. The gas which burns over a "gas-burner" is formed by the action of heat on coal.

By the heating of any of these substances many different kinds of gas are produced, some of which become liquids if they are allowed to cool, while others are permanently gaseous. In the case of candles and lamps, when the hot gas is burnt as fast as it is made, the uncondensable and the condensable are burnt alike, the latter contributing even more than the former to the luminosity of the flame. In the case of coal-gas, which is kept for many hours, and has often to travel along many miles of iron piping before it is burnt, only very little condensable gas reaches the burner. In this respect "gas" illumination is at a great disadvantage as compared with candles or lamps. To counterbalance this disadvantage gas must be produced from some substance which is much cheaper than grease or oil, and such a substance we have in coal. But coal, like all minerals obtained on the large scale, is mixed with small quantities of other substances, and, in particular, masses of coal always contain a greater or less proportion of a mineral known, according to its form, as pyrites or marcasite, composed of eight parts of sulphur united with seven of iron. When coal is heated, a part of the sulphur from this mineral unites with the carbon and hydrogen of the coal, and thus the illuminating gas formed from coal is contaminated with at least two sulphur compounds—carbon bisulphide and hydrogen sulphide Such gas yields when it is burnt, in addition to water and carbon dioxide, sulphur dioxide produced by the burning of the sulphur. This gas has a well-known pungent smell; it acts on various coloring matters, and it is gradually changed in presence of air and moisture into a far more destructive substance, called hydrogen sulphate or oil of vitriol. Unlike sulphur dioxide, which is a gas and can be removed by ventilation, hydrogen sulphate is not volatile, and exercises a continued corrosive action upon organic materials or fabrics on which it is deposited. In a furnished room the leather bindings of books and coverings of furniture are especially liable to be injured thus; perhaps because this material, being a better conductor of heat than others which are used for the same purposes, is more bedewed after gas has been lighted in a room than they are, and also because it requires less often to be cleaned or renewed. Fortunately the conversion of sulphur dioxide into hydrogen sulphate takes place so slowly that in a room lighted with gas and well ventilated a very small part of the sulphur which gas as at present manufactured is liable to contain is very small. In a room lighted with four gas-burners the volume of sulphur dioxide mixed with the atmosphere of the room in the course of an hour is about one-hundreth of a cubic foot. The amount actually present at any moment, if the room is fairly ventilated, is a small fraction of this volume. Nevertheless, it is possible, and even probable, that some injury, especially to the bindings of books, may in the course of years be caused under these circumstances; and it is desirable, with a view to avoiding any such injury, and also with a view to allaying the apprehension of it, that the proportion of sulphur compounds in coal-gas should be reduced as far as possible.

A ton of coal may contain about 30 lbs. of sulphur; it yields nearly 10,000 cubic feet of gas, and a considerable part of the sulphur contained in it is given off with the gas in combination with either carbon or hydrogen. Of these two elements, hydrogen claims by far the larger proportion, not less than 10 parts for 1 that is united with carbon. For the purification of gas from hydrogen sulphide, excellent methods are everywhere in use. The gas is passed through layers of slaked lime or of iron oxide, by either of which substances all the hydrogen sulphide is capable of being completely absorbed. But the smaller quantity of sulphur existing in the form of carbon bisulphide is not arrested by these agents, nor is there at present any material or process known by which it can be effectually removed.

When coal-gas which is pure from hydrogen sulphide is heated and tested again, it is found to contain this impurity, and showing that some ingredients of the gas are capable of producing hydrogen sulphide by their mutual action. Hydrogen seems to have a much stronger affinity for sulphur than carbon has. One consequence of this difference is the unequal partition of the sulphur between the two elements in the gas retort. But this inequality does not reach its limit in the short time which elapses between the formation and cooling down of the gas: and accordingly, when foul gas (or gas which has not been purified from hydrogen sulphide) is further heated, the proportion of hydrogen sulphide in it is increased, and that of carbon bisulphide diminished. From a number of experiments in which foul gas was passed through an iron tube three inches in diameter, filled with iron turnings and heated for a length of about two feet to low redness, it appeared that the amount of carbon bisulphide could be so far reduced that the gas, after purification from hydrogen sulphide, contained five or six instead of 30 grains of sulphur in 100 cubic feet. The gas was driven through the heated tube at a rate of from one to two cubic feet a minute.

A somewhat greater reduction in the amount of sulphur is obtained by heating the gas after, instead of before, purification and purifying it a second time. If it is the case, as seems probable, that the sulphur present in coal-gas distributes itself when the gas is heated between the carbon and hydrogen in a ratio dependent upon the relative affinity for sulphur of the two elements, the proportion of carbon bisulphide to the total sulphur in the gas will be always the same when the composition of the gas is the same, and when it has been heated long enough for the establishment of an equilibrium. Accordingly we should expect the removal of sulphur, by the conversion of carbon bisulphide into hydrogen sulphide and the absorption of the latter, to be accomplished more effectually with gas from which the chief part of the sulphur had already been extracted. And this, as has already been stated, is found to be the case.

The nature of the chemical change which takes place when coal-gas is heated, may be illustrated by passing hydrogen over the mouth of a tube containing carbon bisulphide, and thence through a piece of combustion tubing heated nearly to a red heat. The mixture of hydrogen and carbon bisulphide vapor has no action on a solution of lead acetate; but, after the application of heat, the gas which issues produces at once a black precipitate, proving that hydrogen sulphide has been formed. This change occurs readily with hydrogen which has been carefully dried; but the presence of moisture appears to promote it; and as coal-gas contains a quantity of aqueous vapor, much more than sufficient to react with the maximum amount of carbon bisulphide, it is possible that the formation of hydrogen sulphide when coal-gas is heated may be partly due to the intervention of moisture.

If clean iron nails are heated to redness in a glass tube, and coal-gas is passed slowly over them, a soft black carbonaceous deposit is formed, and the gas is deprived of a part of its carbon. If, however, the gas be passed through more rapidly, no such deposition takes place, although the time of contact of the gas with the heated surface is still sufficient to effect the conversion of the carbon bisulphide into hydrogen sulphide. In the latter case it may be presumed that no change occurs in the illuminating power of the gas. But to establish a point which is of capital importance, some direct observations were made on the illuminating power of gas thus treated. It was found with gas passing at the rate of five cubic feet an hour through a half-inch iron tube, heated for a length of twelve inches, that, when the heat did not exceed low redness, no change was observable. When the heat was raised to bright redness, there was a perceptible increase in the illuminating power.

If the process of heating coal-gas, in order to remove the sulphur contained in it, should be employed on the manufacturing scale, the rate of transmission of the gas through the heating apparatus would necessarily be such as to render any deposition of carbon

very unlikely. But even where such deposition takes place, it is not necessarily accompanied by a diminution of the illuminating power.

An interesting experiment, from this point of view, is the decomposition of marsh-gas by the electric spark. When a stream of sparks from a Ruhmkorff coal is transmitted between the ends of platinum wires through a small quantity of marsh-gas enclosed in a glass tube over mercury, the gas gradually expands In about ten minutes it is nearly doubled, and at the same time a black deposit appears on the tube, in the neighborhood of the wires. Here the intense heat applied has effected an almost complete decomposition of the hydrocarbon into its elements. But at the same time there is found a small quantity of some more condensed hydrocarbon, probably acetylene. On expelling the gas through a jet attached to the upper end of the tube, and burning it, the flame is seen to be much more luminous than that of marsh-gas itself. The fact of which this experiment gives a striking illustration is that the illuminating power of gas depends much more upon the nature of the hydrocarbons it contains than upon the total amount of carbon. How great would be the gain to the manufacturers of coal-gas, if such an operation as this were possible on the large scale, by which the volume of gas is doubled, and its illuminating power, at the same time, greatly increased!

As far as chemistry is concerned, the simple operation of heating gas appears to offer the means of a sufficiently perfect purification. The construction of a suitable system of iron pipes for heating the gas, and the best mode of obtaining and applying heat, is a problem for the engineer. On the scale on which gas is manufactured, all the apparatus for dealing with it must be of a magnitude to which it is difficult to pass, even in imagination, from the small scale of laboratory experiments; but, otherwise, the problem does not appear to be one of any peculiar difficulty. It may perhaps be found possible to employ some of the waste heat of the retort-house for this purpose, and thus to effect the required purification without much increasing the consumption of fuel.

Forests and Drought.

T. S., of Pa., writes to say that it lies with us to decide whether our continent shall retain its present luxuriance and salubrity to remote ages or not. He regrets the rapid diminution of our forests, and the decrease of moisture in the interior parts of the country; and concerning the latter point he states that, in some parts of the country, where five feet of snow usually fell in a year, there is not now five inches.

"Sardinia and Sicily, once the granaries of Italy, have suffered the penalty of their thoughtlessness in exterminating their forests. Two thousand years ago, those lands were celebrated for their wonderful productiveness, and were said to be the most beautiful in the world. In 1800, Humboldt visited Venezuela, South America, and was informed by the natives living in the valley of Araguay that they had noticed, with great astonishment, that a lake which lay in the middle of the valley had decreased in volume every year; the cause of this is clearly traced to the felling of a great number of trees which grew on the surrounding mountains. In Hungary the periodical droughts are universally attributed to the annihilation of the forests. In Cairo, Lower Egypt, a great many years ago, rain fell but seldom, only once in three or four years; but since the time of Mohammed Ali, twenty to thirty millions of trees have been planted, and the result is now that the people have from thirty to forty rainy days every year. Surely these few of the many examples are warnings sufficient to put us on our guard."—*Scientific American.*

Prof. Pumpelly, State Geologist of Missouri, advises each county in that State to obtain a diamond drill and prospect, not for minerals, but for geological sections; and the suggestion is so good that it will probably be adopted.

Chemical Repertory.

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EDITOR—HENRY WURTZ.

CHEMICAL EXCERPTS.

648. Resistance to Freezing.—Krebs has devised a very simple arrangement, by which it is possible to show to an audience that water may be cooled considbelow 32° F. without freezing. He takes a tube 18 centimeters long and 1 centimeter wide, made of thick glass, closed at one end and furnished with a bulb. After thoroughly cleaning by heating sulphuric acid in it for some time and rinsing repeatedly with distilled water, he draws out the upper end to a long point. This point is kept dipping in distilled water, which has been boiled for some time. Every time the bulb is heated and allowed to cool, a little water enters. This is repeated until the tube is full clear up to the point. Then the point is made to dip into purified mercury and heat is applied to the bottom of the tube until the water reaches only half way up in the bulb, when the point is quickly sealed up by melting.

Placed in a freezing mixture, say of water and nitrate of ammonia, side by side with water in an open tube, it can be taken out and handled after the latter is frozen, without being congealed by the agitation After the water in the open tube is completely frozen, that in the closed tube will freeze suddenly, if it is strongly shaken up and down once.

649. Drainage in Italy.—Most continental travellers are acquainted with that vast expanse of water in Northern Italy known as the Ferara Marshes, covering nearly 200 square miles of what was once the most fertile land in Italy. An Anglo-Italian company has been formed for the purpose of reclaiming these watery wastes, and plans for accomplishing the work were solicited from the most celebrated hydraulic engineers in England and on the continent, and the choice fell on Messrs. John and Henry Gwine, of Hammersmith, England, to whom the contract for the whole of the machinery has been given. The body of water to be drawn off the land is over 2000 tons per minute, and as the consumption of fuel was a consideration of primary importance, these gentlemen have guaranteed that the maximum consumption of coal shall not exceed $1\frac{3}{4}$ lb. per indicated horse-power per hour, and to deliver the whole of the machinery in ten months. The engines will be on the compound surface condensing principle, of 1400 horse-power, working centrifugal pumps, and, we believe, are the first that have been constructed for drainage purposes on this principle.—*Eng. and Min. Jour.*

650. New British Coal Openings.—A Barnsley correspondent of the Sheffield *Telegraph* says; A vast and valuable field of coal, extending for many miles, is about to be opened out at Worsborough, near Barnsley. It may not be generally known that what is known in Yorkshire as the "Barnsley Bed" of coal, and in Derbyshire as the "Top Hards," is the most extensive mineral field in England, extending from a point close to Nottingham, its southern extremity, to the northwest of Normanton, a distance of more than 60 miles in a straight line. Below the Barnsley seam is the Silkstone seam, one of the finest in the kingdom, either for gas or household purposes, the distance between the two beds averaging 380 yards. The Silkstone seam has so far only been worked, but it is now proposed to sink, through the intervening strata, to it on the estate of Mr. Edmunds, of Worsborough Hall; the Barrow Iron and Steel Company having just secured 900 acres of the coal, and in all probability will take a much larger area. It is understood that the Barrow company will make the greater portion of the coal raised into coke for supplying their many furnaces. Thus a really new field will be opened out, containing many million tons of coal, and embracing an area that can only be computed by miles. It may be said that Mr. Hull, in his work on coal fields, states that at one time the Silkstone coal must have covered an area of 10,000 square miles.—*Iron Age.*

651. Whence the Authority?—The *American Artisan* informs a correspondent that "pure glycerine does not attack any metal," but that "when used in gas meters, however, there are formed in it certain acid products which corrode the metal and speedily destroy it."

We wish our contemporary would give us the source of his information. It does not accord with our own.

652. Coffee as a Deodorizer.—Recent investigation has proved that coffee is a powerful disinfectant, not only rendering animal and vegetable effluvia harmless, but actually destroying them. A room, in which meat in an advanced state of decomposition had been kept for a long time, was directly deprived of all smell, on an open coffee roaster being carried through it, containing a pound of coffee freshly roasted. The offensive odors of a cesspool, it is declared, may be in this way speedily and effectually removed. It is hardly necessary to add that the coffee must be pure.—*Dr. Wahl.*

653. Water Supply of the Vienna Exhibition.—It is stated that the total quantity of water to be supplied for all purposes, inclusive of fountains, driving of machinery, etc., amounts to 1240 cubic meters per hour; a quantity sufficient for a population of 200,000.

654. Reactions of Carbon, Iron, and Carbonic Acid.—M. Dumas, in a note of experiments communicated to the Academy of Sciences, draws the following conclusions: That carbonic acid absolutely dry, passing over charcoal, entirely free from hydrogen, is converted, at a bright red heat, into carbonic oxide; that if the charcoal is in excess, the carbonic acid disappears entirely, and is replaced by perfectly pure carbonic oxide. Charcoal, to whatever degree it be heated, retains either hydrogen or water, from which it can only be freed by the prolonged action of chlorine at a red heat. Charcoal which has not been submitted to the treatment by chlorine, when used to convert carbonic acid into carbonic oxide, always yields a gas accompanied by traces of hydrogen. A slow current of dry carbonic acid is partially converted by iron, heated to a bright red heat, into carbonic oxide, a considerable portion of carbonic acid, however, remaining unaltered or undergoing regeneration.—*Scientific American.*

655. Curious Views and Statements.—The *Scientific American*, under the heading of "Scientific and Mechanical Possibilities," in an article which has been widely copied, inculcates the idea that evolution of gas from rocks is an indication of petroleum. We fear not.

In the same article, our *confrere* makes the statement that *aluminium* is "three times stronger than steel." We are curious to know who has demonstrated this fact.

"Gas wells in various localities indicate that immense deposits of coal oil and petroleum exist in the earth, which may be at great depths; and New England may yet count it among her treasures, and large and enduring deposits, which few now dream of, be found. We may burn it for fuel as well as for illumination; by its use steam boats may cross the ocean, and locomotives fly by its aid. We are just beginning to learn the power of this new servant that man has awakened from the sleep of ages. The country also abounds in limestone, sandstone and bituminous shales, which, by scientific and mechanical aid, may afford an almost never-ending supply of this wonderful material."

656. The Silber Light.—An English inventor, a Mr. Silber, has lately made various improvements in oil lighting, to some of which the London *Times* of a late date refers in favorable terms Among other lamps to which Mr. Silber has applied his principle are the side and masthead lights used on ships. He

has perfected a covering for these lanterns which, while permitting the free outward passage of heated air from the flame, is completely impenetrable to water washing over it. Waves breaking over side lights so constructed would have no power to extinguish the flame. Satisfactory experiments made with these lamps have amply proved their serviceableness. The principle of construction of these ship lanterns is analogous to that adopted to afford protection against currents of air in the case of street lamps and railway roof lamps. For domestic uses Mr. Silber has also made Moderator and Argand table-lamps, burning colza oil. Tests have shown that lamps constructed on this principle for the same consumption of oil will give about 40 or 50 per cent. increase of light over those of ordinary construction.

657. Improved Cask.—A Mr. Trimmer has recently invented a cask, which consists in making one or both ends partly or entirely of glass, so that the observer may see whether it is full when delivered, when it has become sufficiently empty to replace it with a fresh one, at what rate its contents are being reduced, and also, when empty, whether the cask has been properly cleaned. The inventor, in some cases, uses a cask head made entirely of glass, and in others a strip of glass let in vertically or diagonally, and properly secured from leakage.—*Scientific American.*

758. Action of India Rubber Tubing on the Illuminating Power of Street Gas.—In determining the illuminating power of street gas, it should not be conducted through an india rubber tube, since this diminishes its illuminating power. A series of experiments, made by Zulkowsky, show that the weight of the tube increases. This phenomena is probably due to the absorption of the heavy hydrocarbons by the tubing.—*Jour. Applied Chemistry.*

659. New Transformation Scenes.—The *Mechanics' Magazine*, published in London, proposes that light, flimsy dresses, for ladies, be made of gun cotton. This would be perfectly safe; when taking fire they flash up so quickly, that it has no time to injure the person wearing them, as is proved by the well-known experiment of burning, safely, gun cotton on the palm of the hand. An ordinary dress burns so long as to injure the wearer severely, while in a gun cotton dress a lady may take a bath of blazes, for a fraction of a second, with perfect impunity, to say nothing of the transformation effected in the external appearance, and the new sensation produced thereby. We propose, that with due precautions (for instance, wearing under the gun cotton dress a different attire, made of material rendered incombustible by tungstate of soda), this idea be made practical among the ballet dancers, in the transformation scenes, in some of our modern New York theatres.—*Manufacturer and Builder.*

660. Superior Adhesive Paste.—Take four parts by weight of good glue and cover it with fifteen parts of cold water, allow it to stand for a few hours, and then gently heat until a clear solution results. Dilute the mixture with sixty-five parts by weight of boiling water under constant stirring. In the meantime prepare a paste of thirty parts by weight of starch and twenty parts of water, avoiding all lumps. Into this pour the boiling hot solution of glue, under constant stirring, and keep the mixture boiling. After it is cold add ten drops of carbolic acid. This paste is unusually adhesive. It can be used on leather, paper, pasteboard and parchment, and if it be kept in closed bottles, to prevent the evaporation of water, may be preserved for a long time. In cases where ordinary stock paste will answer every purpose, it is always well to add a few drops of carbolic acid to avoid fermentation or molding.—*Jour. Applied Chemistry.*

661. The Eye and the Sun.—Mr. Oliver Byrns, of Canada, has forwarded to us a pamphlet in which he argues that, because the pupil of the eye becomes expanded during the darkness of night, the disk of the sun on its rising is apparently larger than when that luminary reaches the zenith. He also says that when the sun is in the horizon its rays have to pass through a thicker stratum of air than when it is overhead; that the atoms of air are competent to intercept a portion of the sunlight on its passage, and the greater the distance of the air to be passed through, the more light will be cut off. Hence the gross amount of light which reaches the observer's eyes will increase from sunrise till midday, and decrease from midday to sun set, and the pupils will contract and expand in proportion. He finally thinks the time may come when the orbit of the earth will be found a circle. Comment on such theories is useless. They indicate a mental atmosphere of ignorance of astronomy, optics, and physiology so dense that the strongest light of common sense would become utterly absorbed in endeavoring to permeate its obscurity. We suppose that if this philosopher took a dose of belladonna or inserted a little atropia in his visual organs, he would expect to see the sun cover nearly the entire firmament.—*Scientific American.*

662. Effect of Different Colored Light Upon the Amount of Carbonic Acid Gas in Respiration.—Two Italian investigators, Selmi and Piacentini, have instituted an interesting series of experiments to determine whether different colors affected the respiration of animals as they are known to affect plants. The animal to be experimented upon was placed in an air tight box into which no light could penetrate except such as passed through glass of a given color. Air freed of carbonic acid was constantly admitted into the box, and escaped by a second opening, where it was passed through a vessel which contained some absorbent of carbonic acid, so that its amount could be accurately determined. Representing the quantity of carbonic acid respired by a dog in a given time, under white glass, by 100, the amount given off under black glass was 82·07; under violet, 87·73; under red, 92; under blue, 103·77; under green, 106·03, and under yellow, 126·83. The difference was still greater when the experiment was tried on a pigeon and on a hen. The authors came to the conclusion that green and yellow rays, which are the most important to the vegetable kingdom in taking up carbonic acid, are also most favorable to the respiration of animals, that is, enable them to give off the most carbonic acid. Previous investigators have reported in favor of blue glass, so that the question is not yet fully settled.

663. Varnishing for Balloons.—The navigable balloon of M. Dupuy de Lome, the distinguished French engineer, is varnished with a composition made up of three equal parts of gelatine, glycerine, and tannin, dissolved in 12 parts of pyroligneous acid. It was reported that this compound had seriously injured the balloon, but the inventor denies this, and says that the varnish has been on fourteen months, and is in perfect condition.—*Eng. and Min. Jour.*

Residual Products Obtained by the Metropolitan Companies in 1871.

At page 751 of our last volume (No. for October 10, 1871) we gave, in compliance with the suggestion of a correspondent, and in order to complete our analyses of the accounts of the metropolitan gas companies, a statement showing the quantities of coke, breeze, tar, and ammoniacal liquer produced from each ton of coal carbonized in the year. We append to-day another such a table for the year 1871; but the reader who compares this with the former will remark differences which require explanation. Last year only the residuals *sold* were taken into the account. This year we have calculated from the *estimated production*, which we believe gives a clearer view of the manufacturing results, and it was evidently these our correspondent wished to see. The greatest difference will, of course, be seen under the head of coke, and it is accounted for by the fact that we have now taken the quantity used in manufacture into the calculation; and the widest variation will be remarked in the case of the Western (cannel) Company, who use more coke than they sell; all the other companies sell much more than they use. Though necessarily imperfect, the table is not without interest as exhibiting the estimated working results, which, in this table, look singularly uniform, bearing in mind differences in the quality of coal.

Table of the Residuals per ton of Coals Carbonized and Used, produced by the Metropolitan Gas Companies in the Year 1871.

Name of Company.	Coke per ton of coals in bushels.	Breeze per ton of coals in bushels.	Tar per ton of coals in gallons.	Ammoniacal liquor per ton of coals in gallons.
Chartered	34·02	3·30	9·79	20·46
Commercial	32·44	3·62	9·09	14·78
Imperial	36·02	4·68	8·87	12·83
Independent	35·44	·83	10·14	11·69
London	33·82	4·22	9·21	11·74
Phœnix	35·99	2·22	9·84	17·71
Ratcliff	34·67	2·52	7·78	34·62
South Metropolitan	34·55	1·76	9·46	21·66
Surrey Consumers	33·82	2·19	8·10	10·38
Western (cannel only)	24·30	8·37	10·76	12·02
Average	33·50	3·37	9·30	16·58
Average, excluding Western Company	34·53	2·81	9·14	17·09

The ammoniacal liquor produced by the Ratcliff Company must have been weak scrubbing liquor, unless there is some error in the return.—*Lond Jour. of Gas-Lighting.*

Superheated Steam in House Warming.

Fire-Marshal McSpedon having recently expressed the opinion that conflagrations sometimes originate fram superheated steam in steam pipes connected with boilers, and used for warming houses, igniting the wood-work in the neighborhood of the pipes, a lively discussion of the subject has taken place in the newspapers, in which the worthy Marshal's scientific views have been roughly handled. But though the precise conditions of danger which he has imagined do not exist, it does not follow that there is no source of possible danger in the use of steam. The question is really, not whether superheated steam can ignite wood, but whether steam may become so superheated as to do so, in the ordinary warming apparatus. Superheated steam is itself a vague term, so far as the expression of any particular temperature is concerned. It may be red hot, or it may be but slightly above the so-called boiling-point of water.

From the mass of articles which have appeared on this subject we select a letter, originally written to the New York *Herald*, over the signature of "H. F. W.," which gives a very clear and practical statement of the facts and principles involved. The author is Mr. Henry F. Worthington, an intelligent and rising engineer, at present residing in New Jersey, and, we believe, a member elect of the Legislature of that State. As the son of Mr. H. R. Worthington, one of our leading steam and hydraulic engineers, this gentleman has had excellent opportunities to master both the theory and the practice of these branches; and we commend his plain and conclusive statement to all whose fears need soothing, or whose notions of the matter under discussion are confused.

To what Mr. Worthington says we venture to add a word or two, pointing out dangers which the use of steam heating-apparatus may involve, apart from an y

supposed superheating of the steam. In the first place, it should be borne in mind that such apparatus subjects all the wood-work of a house to a process of kiln-drying, prolonged through years. This is the case whether the steam in the pipes is ever superheated or not. It is the case when hot air is used instead of steam, and particularly and alarmingly when there is any leak in the hot-air conductors, so that the air, hungry for moisture, comes in contact with floors or joists. Mere ventilation dries wood to tinder in the course of time. This was terribly illustrated by the fury with which the timber in the Crown Point, Kentuck, and Yellow Jacket mines at Virginia City, Nevada, burned at the time of the great fire, several years ago. People who prate of the heat obtained from moisture in fuel, should study the way in which wood burns when the moisture has been thoroughly dried out of it.

This source of danger is not peculiar to any method of heating houses. It arises from the fact that when we heat wood we expel moisture from it, and when we heat air we increase its capacity to take up moisture. The materials being thus kiln-dried, slight causes will ignite them. Great fires in mines have arisen from the dropping of a candle upon dessicated timber; and the wood work of our houses may be ignited like shavings by the flame of a lucifer match. We wonder, by the way, how many lucifer matches there are in this community lying along the edges of carpets, or hanging in waistcoat-pockets alongside of the hot-air or steam-pipes in closets, or hidden in the walls, where they have been dragged with other rubbish by the rats! A friend of ours recently made a cruise of exploration in his house, and discovered half-a-dozen unburned matches and match-heads in places where their accidental ignition would have set fire to steam-dried wood-workr Some of them were behind a steam radiator, and a fire resulting from them might well have been charged to the action of "superheated steam." We have heard it said by a shrewd and experienced engineer, that if matches were as dear as segars, so that people would keenly look for them when dropped, or miss them when mislaid, the Fire Marshal would have little to do.

But another source of danger, peculiar to steam-pipes and hot-water pipes, is the explosion of the boilers. Here it is not superheated steam. but saturated steam, which is a much more terrible agent, with which we have to do. Many boilers used in families for heating water or steam-warming are without safety valves, and depend on the regulation of pressure which results from the amount, circulation, and head of the water. If the pipes become plugged with ice, on a cold night, the boiler and fire-back may be hermetically closed, and thus may constitute an instrument charged with the greatest danger. An explosion during the recent cold term, reported the other day in the newspapers, illustrates this warning. People should be careful about heating up when they have reason to fear ice in the pipes; and above all, no false economy should cause the omission of safety-valves in any apparatus where steam is generated.—*Engineer and Mining Journal.*

More Light.

The duplex tendency of modern science, to multiply the number of observed phenomena and at the same time to simplify our interpretation of them by bringing, into consistent and comprehensible order, facts that have seemed to be capricious, irregular, and isolated, is happily shown in the latest discoveries in regard to the nature of sunlight.

Hitherty the sunbeam has been thought to have a three-fold character. It illuminates, warms, and induces chemical changes; hence the inference has been that it must be composed of three distinct sorts of rays, interwoven like the triple strands of a cord but disentangled when subjected to the refracting influence of a lens or a prism. The evidence for this view has been very convincing. That the maximum illuminating power of the solar beam lies in the yellow portion of the spectrum is patent to every observer. Sir William Herschel found, by careful thermometric study of the spectrum formed with a prism of glass, a very unequal distribution of heating rays; there are very few in the violet end, from which point they increase slowly through the green, blue, and yellow, very rapidly in the red, and attain their maximum manifestation in the invisible portion of the spectrum below the red. Dr. Wollaston, experimenting with the sensitive salts of silver, developed a similar inequality in the distribution of the so-called chemical rays, their intensest influence appearing in the violet and ultra-violet portion of the spectrum. From these and a multitude of later observations, telling substantially the same story, the supposed three-fold character of the solar emanations has come to be a generally accepted article of scientific belief Now, however, it appears that, while the observations were correct, the inference drawn from them was a mistake. Nearly thirty years ago, Dr. Draper called attention to an inherent defect in the prismatic spectrum, a defect originating in the very cause which gives rise to the spectrum, namely, unequal refrangibility. The rays toward the violet end are much more widely separated than those of the red end, and consequently a smaller number fall upon any given surface—as for example, the bulb of a thermometer—and produce proportionately a smaller thermic effect. The fact, therefore, that the temperature of the violet portion of the spectrum is lower than that of the red does not prove absolutely that a violet ray has a lower heating power than a red ray, though it would seem so at first sight; the observed inequality may, and as experiment shows, does arise wholly from the nature of the prism.

By an elaborate series of experiments, Dr. Thayer has just shown that, if the visible spectrum be divided into two equal portions and all the more refrangible rays be collected into one focal group, and all the less refrangible into another, the heat-producing powers of the two are practically equal, instead of being strikingly unequal as they would be if the current belief were correct. He chooses, as the optical center of the visible spectrum, the ray having a wave length of 5768—the mean between the wave lengths of the less and more refrangible ends—and proves the portions on either side to have heating powers "so nearly equal that we may impute the difference to errors of experimentation." This demolishes the opinion that there exists in the solar spectrum a heat spectrum covering the less refrangible regions. Does the belief in a chemical spectrum in the more refrangible regions also stand on untenable ground?

Dr. Draper promises to publish soon the result of his studies in regard to the actinic power of the sunbeam. From intimations already given, we may infer that he will demonstrate the chemical power of rays of every kind, whether of low or high refrangibility, and thus bring this property of the sunbeam, as he does its heating power, into perfect harmony with the modern doctrine of the conservation and transmutation of motion.

The same result, we may add, has been arrived at by the European observer, Professor, Lommel, who remarks, in a recent paper, that the curve of so-called chemical intensity only indicates the relation of the sun rays to certain reagents. Different substances absorb different rays, and chemical action, like light and heat, arises solely from such absorption. The fact that the violet and ultra-violet rays act with a special force on the salts of silver is no reason for distinguishing them as *the* chemical rays. Other substances are chemically affected by entirely different rays, as for instance the coloring matter of plant leaves, chlorophyll, which is acted on chiefly by red light.

It is worthy of notice that, while these important discoveries naturally modify scientific opinion, the change is—like all scientific progress—toward a simpler expression of knowledge; the supposed existence of various principles in the solar emanation disappears to give place to a view in harmony with the widest generalization yet made by man, namely, that there is neither heat, light, nor chemical action in the sun ray, but simply motion, which develops any or all of these manifestations according to the nature of the absorbing substance.—*Sci. Am.*

On the Means of Regulating Gas-Flames so as to Obtain a Constant Temperature Higher than the Boiling Point of Mercury.

By J. Myers.

Jeannel and Martenson have recently published descriptions of regulators of temperature, by means of which a constant temperature higher than that of the boiling-point of mercury may be kept up. It is unnecessary to enter here into details of the construction of these apparatus; suffice it to say that air is applied in them as the expanding medium.

While engaged in a series of experiments on the process of dissociation of oxide of mercury, I required a high, but constant and only slightly varying, temperature for a considerable length of time, and for that purpose constructed a modification of Schlossing's apparatus, in which, in lieu of a mercury reservoir, an air reservoir is used, consisting of four glass tubes placed side by side and tied to each other, each tube 15 centimeters long by two centimeters diameter. This apparatus was placed into an air-bath, through a slit cut in the top of it, at the side where the door is placed, care being taken that the bath is air-tight, while it is heated by means of gas, which can be supplied at any desired pressure. When it was desirable to heat the bath to a high temperature, say 250°, the quantity of gas required for that purpose was found too large to be regulated by the apparatus, since the distance between the supply-pipe of the gas and the caoutchouc caps (probably those connecting the above-mentioned glass tubes) had to be too great, this being due to the great loss of heat—by radiation—from the non-heated sides of the air-bath, which, in order to be heated to the boiling point of mercury, requires a very large bulk of gas.

It is through the kindness of Professor Gunning that I have been enabled to make these experiments, because, as the pressure usually kept up in street gas-mains is not strong enough for this purpose, I was compelled to supply gas to the burners by means of a separate gasholder. When the supply of gas reached a given pressure I was enabled to bring the temperature of the air-bath up to 350° by the use of four Bunsen burners, which temperature could be kept up constantly with very slight variations; with five such burners I could bring the temperature up to 365°. It is of course evident that neither Jeannel's or Martenson's instruments, nor my own, can be used for regulating temperatures above that of the boiling-point of mercury, an observation more particularly applicable to the apparatus of the first-named gentleman, in which the outlet opening is very small; perhaps by placing the instrumeuts in a bath of molten metal—lead or zinc, for instance—regulation of the temperature might still be possible, but the instruments are not well-suited for such use. If an air-bath were so constructed that the loss of heat from the metal by radiation were either entirely prevented or greatly reduced, it might be possible for my modification of Schlossing's apparatus, if of larger size, to be found to answer for regulation and constant maintenance of higher temperatures; as long as this is not effectually done we need not hope to be able to regulate high temperatures. I say this because the assertion to the contrary made by Martenson and Jeannel, based simply upon the fact that air is the expanding medium in their apparatus, is not proved by facts. The instrument used by me enables me to regulate with great precision the temperature of either an air or oil-bath, since the limit of variation of temperature is only about $\frac{1}{2}$°. The volume of air heated in my instrument is greater than in those alluded to, and my instrument is also more air-tight than theirs; I can therefore, upon experimental grounds, recommend the use of my

modification of Schlossing's apparatus whenever a very constant and only slightly varying temperature is required.—*Chem. News, from Ber. d. Deutsch. Chem. Gesells.*

England's Coal.

The report of the coal commission has been severely criticised by scientific men and able writers, who argue that the coal of Great Britain will be exhausted in a much shorter period than that calculated by the Commissioners of Parliament.

The commission reports that the probable quantity of coal in the ascertained coal fields of the United Kingdom is 90,207,000,000 tons. This estimate includes everything of the nature of coal that has a seam of more than twelve inches thick and to a depth of four thousand feet. One able writer, in analyzing this estimate, shows that the quantity capable of being extracted at a working depth is not over 61,000,000,000 tons—that is, at a depth above the limit of blood heat. Then it is calculated that only 22,000,000,000 can only be extracted at a cost that at present prices would not pay. Thirty-nine thousand millions of tons, then, this English writer says, is all the coal of the existence of which, within the limits of available working means, there is any evidence. Some sanguine geologists are speculating upon a larger supply from possible undiscovered beds; but there are no facts to sustain such an assumption. The conclusion is, therefore, that 39,000,000,000 of available and 22,000,000,000 tons of less available coal, considering the amount already extracted, are largely in excess of the probable actual quantity. If the present rate of increase of consumption be continued the last ton of the available 39,000,000,000 tons would be extracted in seventy three years. In the year 1869 there were taken from the mines 108,000,000 tons. The amount in 1871 was estimated at nearly 118,000,000 tons. The increase in the year 1869 was equal to that of the two preceeding years. The annual increase, one year after another, is at least, from three to four per cent. and at this rate the consumption would reach in twenty-five years fully 220,000,000,000 tons a year.

It must be remembered, too, that the best coal is generally mined at first. England, consequently, is not only rapidly exhausting the amount of supply, but must depend more and more upon an inferior quality as time advances. Then the additional cost of mining as greater depths are reached, and the inevitable increase of wages with the progress of the age and improving condition of the working classes, must in time seriously affect the manufacturing and commercial facilities and greatness of England. It is admitted that the coal fields of the United Kingdom are in area but four per cent. of those already known in the world. The wonderful growth and present magnitude of English manufactures must be attributed chiefly to the coal fields of the British Isles, and, as a consequence also, England's vast commerce and wealth. Steam power, evolved by the valuable mineral, has given a production that all the labor of the teeming millions of the British Empire could not. As the supply of this material gives out in quantity and quality, and as the cost of extracting it increases, England's manufacturing and commercial supremacy will probably decline. England cannot import coal in such vast quantities as she will need it, and compete with the countries which have it in abundance and from which she must obtain it.—*N. Y. Herald.*

Steam on the Canals.

The commission appointed in 1871 to consider and encourage the practical introduction of steam, caloric, electric, or any motor other than animal power for the propulsion of boats on the canals have completed their report. The commission appointed an engineer to inspect and note the practical operations of boats constructed with this end in view; appointed subcommissions to examine canals where steam power is used, and drafted rules for the government of those who competed for the State prize. The Commissioners say that many have been disappointed because of the severity of the tests required, but the question was one involving many elements, and demanding a practical solution. Before any award can be made the law provides "that the Commissioners shall be fully satisfied that the invention or device will lessen the cost of canal transportation and increase the capacity of the canals."

The report concludes with the following, adopted at the last meeting of the Commission:

Whereas. The preliminary trial trips required by this commission of the several boats competing for the prize of $100,000 offered by the State of New York in chapter 868, Laws of 1871, were not completed in time before the close of navigation in the year 1872, to allow such further tests and examinations as are necessary to enable the commission to determine whether one or more boats had complied with the conditions of the offer made by said law; therefore be it

Resolved. That the commission do not make any award or grant any certificates upon the facts and information now before said commission.

Many of the competitors are anxious for more time to be given them, and the Commission is strongly urged by them and others interested in the matters involved, to recommend to the Legislature that the rewards offered be continued, and that further time be given by the State for the examination and decision of the claims presented under the law.

In the opinion of this commission the conclusions arrived at by the engineer in his report herewith submitted, not only justify further investigation, but present strong reasons why the State should not now abandon the effort to make steam the principal power used on our canals.

This Commission would therefore recommend that the reward offered by Chapter 868, Laws of 1871, be continued under such form or commission as the Legislature may deem proper; and in case it is so continued that an appropriation be made sufficient to defray the probable cost of time and expenses necessarily incurred in discharging the duties prescribed.—*N. Y. Sun.*

Sewage Enterprise.

[From "The Engineer."

A great experiment in the treatment of sewage is about to be made by the city of Paris, or rather by the Peat Engineering and Sewage Filtration Company of London. According to the system pursued for some years past in the French capital, the fecal matters are removed from the houses in carts and wagons, and transmitted to La Villette and Bondy. In some cases the houses have movable receptacles for the purpose of holding the excreta. In other instances the cesspool principle is adopted. As far as possible the liquid is allowed to run off into the sewers, leaving the comparatively solid matter behind for removal by the carts. The movable receptacles are carted to La Villette, where they are transferred to barges, which convey them to Bondy by way of the canal. The excrementitious matter which is not thus packed away is discharged from the vehicles at La Villette, and is thence pumped by steam power through a cast-iron pump to Bondy. At this favored spot the whole of the offensive matter is thrown into a number of open pits some twenty feet deep, occupying several acres of ground. Here a precipitate is formed by evaporation and deposition, five years or more being allowed to elapse before a pit is emptied. The atmospheric evaporation creates a frightful nuisance; but vegetation flourishes amazingly, enriched by the ammonia with which the air is laden. Evaporation, however, fails to do all the work, a portion of the fluid being pumped into the Seine by a small steam-engine. The solid matter removed from the pits is first of all spread out to dry, then stacked up, and finally reduced to powder, in which state it is sold as manure. In addition to the manufacture of this "*poudrette*," the works at Bondy make a certain quantity of sal ammoniac and other chemical products; but "*poudrette*" is the principal article.

The buildings and plant at La Villette and Bondy are maintained at the expense of the Paris authorities. The contractor is paid by the householders, according to a fixed scale, for the removal of the excreta from the premises, while, on the other hand, he—or rather the contractor at Bondy—pays the municipal authorities so much per cubic metre for the matter removed. Formerly the Bondy contractor paid the authorities one franc per cubic metre for the more solid portion, and 1f. 25c. per cubic metre for the liquid. The manufactured article of course belongs to the contractor. In reality there are several contractors or companies dealing with the Paris sewage, and they are not bound to take the excreta to La Villette unless they choose. When the tenders for the treatment of the sewage at Bondy were opened by the municipal authorities the other day, the highest price offered by a Frenchman for the semi-solid excreta was 1f. 30c. per cubic metre. Another party, not a Frenchman, offered 3f. 50c. But when the tender of the Peat Engineering Company was opened a perfect sensation was produced, the terms offered being no less than 6f. 7c. per cubic metre! An inquiry was promptly made whether the deposit money £20,000, had been provided, and this being answered in the affirmative, the tender was accepted, the concession to commence from July 1st. It would appear that the contract now entered into relates solely to the treatment of sewage, and has no reference to the collection. The Peat Engineering Company are bound to deal with all the night soil brought on to the ground at Bondy, the municipal council undertaking that a certain quantity shall be forthcoming, any default in that respect subjecting the authorities to a penalty of half a franc per cubic metre for the quantity deficient. It might be said that the penalty ought to be equal to the price; but of course the authorities made their own terms in regard to the penalty, and evidently never expected to get such a prodigious figure for the article they had to sell.

It is important to know how the Peat Engineering Company can expect to realize a profit on sewage matter bought at so high a price. Their plan is to treat sewage with charcoal, and they calculate that a ton of this disinfecting material is equal to the absorption of at least two tons of solid sewage matter. This they propose to reduce to powder, packing it in bags for conveyance or storage. Their mode of treatment is just coming into operation at Bradford, in Yorkshire, where the sewage of 150,000 inhabitants, amounting to more than 5,000,000 gallons per day, including the waste liquors of numerous dyeworks and factories, is to be filtered through charcoal, arranged in several rows of beds 700 feet long and 4 feet wide, each particle of sewage having to pass through 12 feet of charcoal. The plan has been tried at the workhouse of Stoke-upon-Trent, where the flow is from 10,000 to 20,000 gallons per day, the inmates being 650. The Stoke filters are only equal to the treatment of 10,000 gallons per day, and cannot deal efficiently with the amount of fluid which accrues in wet weather. The charcoal, after doing its work in the filters, is mixed with ashes, and carted to a manure factory at Newcastle-under-Lyme. It is there treated with a mixture of sulphuric acid and ammonia to bring it up to a standard strength, after which it is reduced to powder and sold at £4 per ton. The introduction of ammonia, by which a specified strength is secured, prevents these data from being used as a clue to ascertaining the fertilizing properties of the charcoal as taken from the filters. The company, however, are confident of success.

Nuneaton, in North Warwickshire, having been placed under an injunction by the Court of Chancery, prohibiting the discharge of its sewage into the Anker, has constructed a complete system of sewage, and has availed itself of the patent process of Dr. Anderson, as carried out by the General Sewage and Manure Company. The process is very much like that of the A. B. C. Company, only without the B. and the C. An aluminous shale is treated with sulphuric acid, so as to produce a crude sulphate of alumina. The sewage is admitted into tanks, and the sulphate of alumina, dissolved in water, is then thrown in, followed by a little slacked lime. Sulphate of lime is formed, and the alumina is set free. Precipitation follows, and the water being run off, the mud is discharged into baskets of galvanized iron wire lined with flannel, which act as strainers. As these baskets become filled

with mud they are lifted by means of cranes, and the deposit is thrown on to a floor of sheet iron heated from beneath by hot air from a small furnace, the same hot air being also drawn back over the surface of the mud, and carried into the flue of the engine furnace, with a view to prevent any disagreeable odor. The dried mud forms the manure. Dr. Anderson asserts that at Nuneaton he can produce a ton of manure at a cost of 15s., or from eight to ten tons per week at a cost of £7, including everything. The works are put up at the expense of the local Board o Health, and cost nearly £5000, the Sewage Company paying only £10 a year rent. The population is 7000, and the average daily flow of sewage nearly 200,000 gallons. There are scarcely any water-closets in the town, but factories, tanneries, and mills, together with the house-washings, make a tolerably foul sewage. If there were more water-closets there would be more water, and the sewage might be none the richer—a fact of some consequence in relation to the earth-closet system. That a town with less than twenty water-closets should have an injunction against discharging its sewage into the adjacent river is rather a startling fact But for the injunction, Nuneaton might never have been sewered. The town has been sewered in order to bring all the noxious fluids to one point, there to be dealt with as may be thought best. In order to secure the purity of the effluent water, the Sewage Company propose taking two acres of land to act as a filter. With regard to the quality of the manure, the material at Nuneaton is said to show a value of £2 per ton, according to chemical analysis, and its agricultural value is expected to be higher. The manure is calculated to contain about 20 per cent. of foreign matter and 80 per cent. sewage, the foreign matter being chiefly sand and water. In the A. B. C. manure of the Native Guano Company the sewage matter forms about one half. The manure of the Phosphate Sewage Company—another claimant for the honors of precipitation—is enriched with phosphates on the basis of sewage, and, therefore, commands a higher value. On the other hand, General Scott proposes to burn the organic matter of sewage as so much fuel, to aid the calcination of the deposit, which he thereby converts into Portland cement. General Scott precipitates the suspended matters by adding clay and lime to the sewage, thereby providing a portion of the marerials for forming the cement. Omitting the first outlay, as also the wear and tear of plant, General Scott calculates on a profit of £1 or £1 5s. per 1,000,000 gallons of sewage. At this rate the Nuneaton sewage would only clear about 30s. per week, as compared with Dr. Anderson's estimate of £9 to £13. How far the General Sewage Company may be able to verify this latter estimate, remains to be seen. In either case the effluent water is available for irrigation.

The Sun as a Borer of Mountains.

1. The universe is filled with rays of heat and light, which vibrate among the heavenly bodies perpetually without loss or gain, and which, on alighting upon a heavenly body, pass first into common sensible heat, to be reflected afterward as cold invisible rays.

2. Of the inexhaustible supply of these rays, our sun receives at every instant of time as much as he radiates back again.

3. A portion of his rays fall upon our earth, where they are converted into sensible heat.

4. By means of this sensible heat, water is converted into aqueous vapor; the sensible heat being at the same time changed into so-called *latent*, or chemical motion.

5. Aqueous vapor having less specific gravity than air, it ascends and represents a lifted weight. In this process, heat is converted into motion—the ascent of the weight.

6. The expansion of the air (during which heat is converted into mass-motion) causes the aqueous vapor to be spread over the surface of the earth.

7. By the condensation of the aqueous vapor, chemical motion escapes as common heat, and the resulting water is deposited on the mountain-heights in the form of snow; thus, again, representing a lifted weight.

8. The warm winds from the Mediterranean melt the snow and glacier-ice; sensible heat is thus converted again into insensible chemical motion.

9. The downward current of the Alpine streams generates motion in virtue of their mass, and of the space passed over during their descent.

10. This mass-motion, when temporarily checked by any resisting object, is converted back into heat.

11. Man arrests a portion of this motion by means of a large water-wheel, and, by the aid of a crank and a connecting rod, transmits the motion to the piston-rod of an air-compressor.

12. In compressing air, we accumulate motion as a force or tension; and the compressed air yields this force again without loss—exception made of the loss occasioned by the friction of the piston, which reappears as heat.

13. Compressed air—a storehouse of motion—is made to pass into a contrivance similar to the steam-chest of a steam-engine, where a sliding-valve forces the air to enter alternately above and below the piston to which it thus imparts common mass-motion. The process is the same as the one operating in the steam engine, with the difference that the motor agent is compressed air in place of steam, and that the motion is ultimately obtained, not from the combustion of fuel, but from the descent of water.

14. The mass-motion of the water, now transferred to a drilling machine, is modified by means of mechanical contrivances in a manner such that powerful blows are dealt in rapid succession upon the cutting-tool which drills the hole; mass-motion is thus converted back into heat.

15. The drill hole is filled with a mixture of substances containing chemical motion, which, at any time, may be given out as heat and mechanical motion. By the ignition of the mixture, new combinations of substances occur, which, owing to the new distribution of chemical motion, take up a much greater space, and thereby split the rocks.

16. Mont Cenis tunnel—as will be the future one of St. Gothard—was bored by the sun's heat.—*Mohr, translated by Hotze.*

On Fire for a Century.

At Parkgate, near Sheffield, a most extraordinary phenomenon can be seen by all interested in colliery wonders. About one hundred years ago, several Parkgate gentlemen sank a shaft known as the Old Basset Pit. They at once found a rich seam of coal—the Barnsley bed, nine feet in thickness. This coal was worked in a very careful fashion for several years—great blocks and pillars of coal, containing many tons, being left to support the roof in place of the modern wooden props. For several seasons everything proceeded smoothly; but one day the pit caught fire. Nobody can tell how it was ignited; and the ancient miners appear to have been utterly dismayed by the unexpected disaster, as they left the pit to burn at will, instead of closing up the shaft and commencing anew, as they might have done. Many years afterward "the burning pit" was again approached by the lord of the manor, Earl Fitzwilliam, who began to work out coal in the locality. A shaft was sunk at some distance from the Old Basset Pit, and the coal in the direction of Rawmarsh was got at—the new workings being kept at what was considered a safe distance from the fiery pit. Everything proceeded satisfactorily till 1868, when a miner named Parkin descended the Bank Pit shaft—the name by which the new shaft was known—and was greatly alarmed to find fire only ten feet from the pit bottom. He at once gave the alarm—the principal officials were upon the spot, and efforts made to extinguish the fire. "Parkin's flames" were soon put out; but it was found that the whole pit was on fire, and as the Earl's collieries extended for miles, it was feared that the fire would spread over the entire workings. The Old Basset shaft was at once filled up; the old Bank shaft was also closed; a third shaft, the Top Stubbin Pit, was also filled up. A long and thick wall was built to separate the Old Basset workings from the newly opened portions of the pit. Explorations had to be conducted by crawling on hands and knees in the midst of suffocating smoke; but the wall was at length completed at tremendous expense and great labor—it being 1000 yds. in length, and from one foot to five feet thick. Cross-walls were also built to cut off air-ways, and so help in choking the fire. Thick iron pipes, with iron plugs, were inserted in the wall at intervals of fifty yards, so that views could be obtained of the Old Bassett workings looking through these pipes. The great wall occupied the time of a large body of workmen for a whole year. A new "futtrell"—the entrance to a coal mine—had to be constructed. It had to be brick-arched above and below with strong brick walls. Entering by this place, the wall is inspected daily, to get information if the old fire has reached it in any way. The last fire was seen in 1872, and on being examined lately, nothing but "black damp" came through the orifices; but the most dangerous place—where the workmen labored at a great wall at the peril of their lives—is believed to be the fiery stronghold. Here the flames are still believed to be raging, although securely imprisoned by the work of the underground heroes who built its prison-walls. Until a year or two ago, the farmers found that their crops over this pit were materially accelerated in growth by the heat; and the fact that this acceleration is not so apparent now is the strongest proof to professional minds that the burning pit has about spent its strength after a "long fire" of one hundred years."—*English Paper.*

Colliery Explosions and their Prevention.

In the supplement to the *Mining Journal* of November 18, 1871, we published the substance of an important paper on the Cause and Prevention of Colliery Explosions, read before the South Wales Institute of Engineers by Mr. Thomas Joseph, of Pontypridd, and at the last general meeting of that society Mr. Joseph submitted some Suggestions for Daily Testing the State of a Fiery Colliery in Regard to Ventilation, which were very generally approved of. In addition to the present complete inspection of the travelling roads and working places every morning by the firemen, and report to the underviewer or overman at the bottom of the shaft before the men proceed to their working places, Mr. Joseph suggests that—

1. Before nine o'clock every morning the quantity of air passing through each of the return air-ways near the upcast shaft, at every colliery, shall be carefully measured and registered, and if the total quantity be found to be less than from 80,000 to 100,000 cubic feet per minute, in proportion to 500 tons of coal per day worked (taking those figures for the bases of circulation for larger or smaller quantities), the ventilation should be considered insufficient.

2. At the same time let the friction and drag of the air be tested by the water-gauge at the nearest available points to the upcast shaft, and if it indicates a pressure exceeding an inch and five-tenths in a coal mine, the extreme workings of which are not further than a mile from the shafts, it would be (and it should be considered) evidence that the air-ways are of insufficient section, or that they have been contracted by falls, squeeze, or creep.

3. In the afternoon of every working day, say between the hours of 2 and 4 o'clock, about which time a colliery is in the most unfavorable condition, owing to the travelling of the horses (and each horse vitiates as much air as about ten men), and the disturbance of the ventilation by the opening and closing of so many doors, let the quantity of air passing be carefully measured and registered at the end or face of each split of air for daily comparison, and as a test of leakage.

4. At the same time let the temperature at the working face be tried, which can be done with a pocket thermometer, and if it is found to exceed 65° Fahr. in a colliery, the shafts of which are not deeper than 200 yards, it would be and should be considered unsati-

factory, and be evidence of insufficient ventilation, whether arising from small or contracted air-ways, or insufficient volume of air in the intakes. A high thermometric reading would be usually coincident with a high water-gauge reading.

4A. Let an increase of temperature of 1° Fahr. be allowed for every 20 yards in depth of the shaft beyond 200 yards—thus at 300 yards the maximum tem perature in the working faces should not exceed 70°, and at 400 yards of depth it should not exceed 75°.

5. Let a barometric reading near the bottom of the downcast shaft be registered twice a day in ordinary weather, and be more carefully watched in variable and stormy weather, as a sudden fall of 3-10ths to 4-10ths of an inch sensibly affects the ventilation and condition of safety of a fiery colliery.

6. In addition to the above provisions, let the workmen in every colliery have the option of deputing one or two of their number (being paid by the proprietors) to go with the officers of the colliery through all the travelling roads, working places, return air-ways, and old workings, if any, say twice a month, and sign a record of the same each time in the overman's pit register.

7. Let a complete copy of the pit register, or diary, containing the whole of the above suggested daily records, be sent every calendar month to Her Majesty's Inspector of Mines for the district, signed by the colliery manager, viewer, or under-viewer, who should himself, and would, of course, have tested the correctness of the entries on the entries on the register at once a week.

The discussion upon the paper in which these suggestions were embodied was very animated, and the practicability of them was readily acknowledged; it may, therefore, reasonably be hoped that, as the Coal Mines Regulation Bill is now in Committee, they will receive the careful attention of those who are engaged upon the duty of legislating for the prevention of colliery accidents. There can be no question that by attention to such suggestions as these many of the objectionable clauses in the bill could be dispensed with. —*London Mining Journal.*

Draining the Roman Campagna.

A commission has been appointed to investigate the condition of the Campagna, ascertain the causes of its fatal fevers, and estimate the methods and cost of their removal. That commission has just reported, and the gist of the report is that the Campagna cannot be made salubrious, and that it must continue to encroach upon and depopulate Rome. The real enemy that is striking at her vitals, it appears, is not bad government, nor centuries of misrule, nor dirt and idleness, but—water. The Campagna is a morass that cannot be drained. A thin, crumbly, volcanic soil rests upon a subsoil of water-soaked marsh and drowned decaying vegetation, and this in turn upon an impenetrable foundation of limestone that forbids systematic drainage. Hence the sluggish streams that creep tortuously along and empty themselves into black, metallic, stagnant pools; hence the sulphurous wastes of plain, the fire-burnt hills, the putrefying marshes, the blasted vegetation, the gloomy vapors, and the chill pale mists of this desolate and dreary waste, which looks like what it is, an abandoned cemetery. Hence the begrimed, oozy arches of the long crumbling acqueducts that bestride it like black spiders crawling after their prey; hence the wild eyes, fever-lit, and the yellow, sunken faces, fever-ridden, of the few poor wretches who haunt its ghastly fields, listlessly toiling for money and the grave, and dragging their emaciated bodies about like the patients in a plague-hospital. This Campagna, so fatal, so repulsive, so dreary, has the richest soil in the world; but it cannot be drained, except at such an enormous expense as no government, much less an Italian one, could contemplate; and then the work to be effective would have to be done simultaneously at all parts of its wide area, and to be followed by immediate colonization and cultivation of the soil. This would cost as many lives as the ditching would cost dollars, and indeed it is hardly possible that the enterprise will be undertaken. So long as the Campagna remains undrained the decay of Rome must go on without intermission, and irrespective of Pope or democrat, King or priest.—*Daily Paper.*

The Fragmentation of Leaden Balls by Impact Upon Hard Substances.

Surgeons in army practice have noted with astonishment the fragmentary condition of bullets frequently observed in gunshot wounds. This phenomenon is especially apparent in wounds inflicted by bullets having the rapid rotation imparted by modern firearms. One theory put forth as accounting for this result is that of the conversion of *cis vica*, or stored-up mechanical work, into heat by the sudden arresting of the ball. It has been claimed that the ball is thus raised to so high a temperature as to be fused, and that the fragments found are really small drops or spatters of molten lead scattered in all directions.

That this is impossible may be theoretically demonstrated, as has also been practically shown by some recent French experiments. Mechanical work is never converted into heat except in so far as *mechanical effects are not produced.* In the case of gunshot wounds, the ball in tearing its way through the tissues, or in breaking bones, performs mechanical work equivalent, or very nearly so, to the stored-up force or *cis viva* of the projectile, so that really there is nothing left to be converted into heat.

The experiments of which we have spoken were performed by M. Melsens with balls both of lead and of fusible alloy discharged at high velocities into the carcases of dead horses, under a variety of circumstances, without discovering any indication of fusion.

M. Melsens also experimented with leaden balls discharged at a velocity of over 1200 feet per second, against the surface of an anvil placed against a thick wall, the object being to ascertain whether, when the ball was arrested as instantaneously as possible by an obstacle sensibly unyielding, there would be a sufficient development of heat to produce fusion. An apparatus was devised by which the rebounding fragments of the ball could nearly all be recovered. These fragments, many of them very minute, examined carefully with the microscope, were all irregular, and one could hardly be found which seemed to have a rounded outline like *spatters* or minute drops of molten lead. Moreover, the fragments when first examined, which was, as soon as possible after the discharge, were found quite warm, but not burning hot. From all this the experimenter concluded that very little fusion took place with a leaden ball when discharged, even against a sensibly immovable obstacle.

After a great variety of experiments with leaden balls, of which the point of fusion was 385° Cent., M. Munson tried similar ones with bullets made of Darcet's fusible alloy, which melts at about 95° Cent. (203° Fahr.)

A portion of the ball was fused, but a considerable portion was crushed into fragments without being melted.

Experiments were further tried of impact upon lead, upon wood, upon hard polished stone, upon soft stone, and upon paper. The details of all these experiments are given at length in the *Bulletin de la Societe d'Encouragement pour Industrie National.*

The deduction from all the experiments is that when the ball is arrested instantly by any obstacle which it cannot at all penetrate, a small portion of the ball—the anterior portion—is raised to a high heat; but that when it penetrates any substance little or no heat is developed. A ball fired so as to strike the anvil in a darkened room, gave off at the instant of impact a quite lively yellowish light, showing that great heat was developed; but it is only a very small portion of the ball which is thus heated. Although the heat of that portion which first comes in contact with the obstacle, and is arrested instantly, may be so great as to produce fusion, and even volatilization, the remaining portions expend a considerable portion of their *cis vica* in crushing the metal between them and the obstacle; and this latter effect, being mechanical, does not develop heat.—*American Artisan.*

Magnetic Lock.

One of the most ingenious of mechanisms recently brought forward is the magnetic lock for safes. It consists of four combination wheels, all revolving on one stud; each of these wheels has a single slot or notch in its edge, and the arrangement is such, that when these are all brought into line, the bolt may be thrown.

Over these wheels is a lever or dog, which, when they are all set right, falls into these slots, and releases the bolts. The lever does not rest its weight on the wheels, nor is it brought to them by a spring or cam, as in locks usually, but most of the weight is held off of them by a means of a powerful magnet, Every time the knob is turned around, the magnet is separated from the lever, which, if the slots are all set right, then drops into them thus releasing the bolt.

The operation of the magnet in this manner shuts off entirely the use of the micrometer, an instrument sometimes applied to picking locks. The lever or dog is nearly, but not quite, sustained by the attraction of the magnet, and never comes in full contact with them and the knob outside at the same time, except when in position to unlock. The arbors do not pull out, or shove in, while operating the lock, nor is there any "dead hold" as in many other locks, to which force can be applied so as to wrench off the knob when the lock is in the locked position.

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[Reported Expressly for this Journal.]

MARCH 3, 1873.

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Penn Gas Coal—At Amboy	$6 75	@	0 00
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Consumption of Smoke.

The proprietors of the Cleveland *Herald* have recently applied an apparatus to their office chimney which is claimed to be a perfect preventive of smoke, and a great saver of fuel. The discovery, which the *Herald* thinks is a very valuable one, was purely accidental. A mechanic of that city was trying to secure a better draft for a sluggish fire, and the thought occurred to him after other devices had failed, to try the effects of steam. A small pipe was made to conduct the "dry steam" from the top of the boiler to the

[*For continuation see page* 82.]

THE AMERICAN

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AND

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MONDAY, MARCH 3, 1873.

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NEGLECTED SEWAGE THE CAUSE OF DISEASES.

There is not the least doubt that most of the diseases which fall upon us and shorten life are preventable, for our bodily conditions, like our moral characters, are placed by an all-wise Providence very much in our own power—vigorous strength being the normal state of a well-nourished man, while morbid and stunted physical development, are the results of some known or unknown violations of the laws of our common nature.

No one acquainted with our American cities will be inclined to pronounce their sanitary condition superior to the general average of cities in Europe; and if, as probable, the rate of mortality and the ravages of disease among the industrious millions who crowd our large commercial cities be as great as those of other countries, an amount of human suffering is brought to view, which gives a new interest and importance to any measures of sanitary improvement that come sanctioned by science and experience.

Leaving for the present, other sanitary measures of great value, we propose to treat of that indispensable, though much neglected class which pertain to water supply and sewage; for these are the topics, at the present moment, most adapted for discussion in this journal, and their importance will be seen, if we remember that water mains and sewers are to a great city just what the veins and arteries are to a human body, the one distributing a life-giving stream through every part—the other carrying off those noxious and poisonous substances which would otherwise infuse the elements of destruction and death through every part.

Among the imperfect sanitary conditions which produce so much mischief, are usually found defective water supply, inefficient drainage and the consequent impregnation of the atmosphere with unwholesome emanations from fecal fermentations, foul drains, ditches, and cesspools. Indeed it is the opinion of many eminent medical authorities that typhoid fevers and dysenteries, are sure tests of the sanitary arrangements of any locality, and that neglect of sewage in any town may usually be tracked by the presence of these tell-tale forms of disease.

These opinions are supported by numerous facts; illustrating the tendency of improved sewage to improve the health of cities and towns. In the west end of London and in Westminster, extensive marshes once overspread the banks of the Thames, and malignant fevers annually prevailed. At present efficient drainage and an ample supply of pure water have rendered this district one of the most salubrious in the metropolis. In Paris similar improvements have changed uninhabitable and sickly swamps into the fashionable quarters now known as the Faubourg St. Honore and Montmartre and the Chasse d'Antin.

From these cases and an immense number of others which might be cited, we are authorized to conclude that it is, in the highest degree unwise and even suicidal for any community to allow themselves, in their eagerness for gain, no time or money for the requirements of public health. For the consequences of this neglect, are not only the generation of disease and destruction of life to a fearful extent, but they are hostile to commercial expansion, social improvement and intellectual growth. The energetic inhabitants of New York, profiting little by history, by the disclosures of science, and by the disclosures of sanitary committees, have given too little attention to the prevention of diseases, and to the preservation of the health of the masses. The poor, the sick, and the degraded, have been left unholpen in their filthy retreats, and by a striking kind of retributive law, these have become centers of contagion spreading misery and death around. The yellow fever of this country, the typhoid fever in Europe, the plague in Asia and Africa have scattered desolation and dismay; but have too often failed to fix the attention of the panic-stricken multitudes upon those few simple preventive arrangements, which constitute our chief, and almost only safeguards.

WATER METERS.

We have on several occasions called attention to the adoption of water meters as the only safeguard against the wicked and useless waste of water that is rampant in this city; and are at a loss to understand why the Croton Acqueduct Department does not employ them as a means of checking such waste. It is conceded by all water companies which have used them, that by their adoption many advantages would ensue, and a much less drain be made upon the capacity of the works. Consumers, too, would be benefitted, and although many of them now entertain an unaccountable prejudice against meters, they would be among the first to acknowledge the benefits conferred by them.

At present the price of the forms of meters now made is a serious objection to their general adoption. This we hope to see remedied ere long, but we are of the opinion that, even at present prices, water companies would find it more to their advantage to introduce them than to expend large sums in extensions of reservoirs and new sites for additional works and machinery. Wastefulness, only, would be checked by meters, while all the water absolutely necessary to the wants of a household would be furnished at no greater, and perhaps less expense to the consumer.

It is not necessary that a meter should register by the drop test in our present abundant supply of water; a meter reliable for all ordinary purposes, furnishing an approximate registry of the consumption, will be satisfactory to all over the present unlimited and surprising license granted, as it were, by common consent, to reckless and improvident communities. We notice that the Board of City Works of Brooklyn have taken steps for their adoption and we trust to see New York soon follow in her wake. We therefore call upon the custodians of this vital treasure to take the matter in hand, and have a number of meters manufactured and applied to the supply-pipes of every consumer, so that those who waste may pay for their improvidence.

☞ We have been lately informed that the Pittsburgh Gas-Light Company intend to erect a gas-station, which, when completed, will be be the largest in the United States. The supervision of the works has been entrusted to Mr. William Farmer, the well-known gas engineer of this city. The contract for building the gasholder has been awarded to the firm of Messrs. Morris, Tasker & Co., of Philadelphia, and is calculated to have a capacity of 800,000 cubic feet.

CHANGE OF MANAGEMENT.—We learn that one of the prominent engineers of New England, Mr. Joseph W. Beatly, of late known as Engineer in charge of Gibson's Valve Improvement, is soon o become a resident among us, having been ap-

pointed to take charge of the People's Gas-Light Company's Works, at Brooklyn, E. D., Capt. W. Henry White, the late engineer of the above Company, having resigned to take the management of the Citizens Gas-Light Company's works in the same city.

THE PENNSYLVANIA Legislature has just granted a charter for a new gas works, to be situated in Osceola, Clearfield Co., Pa.

THE BOARD OF CITY WORKS of Brooklyn threaten to renew she water meter scheme, and force meters on the tax-payers at the modest sum of $1,000,000. A waste of water in the city is the latest excuse offered for the scheme. It is said somebody has a patent for the meter.—*N. Y. World, Feb.* 14.

The "New Departure" in Street Lamps.

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"Boulevard" Street and Park Lamps,

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These Lamps, which may now be seen in use in all the Parks, Squares, Boulevards, and leading avenues of New York, and in many cities throughout the world, are made in three Styles. The Plain Lamp without the Reflectors affords more light than any other Lamp in use, and is supplied at a low price. The Street Lamp has, in addition to the above, one Reflector, which is placed upon the top of the iron lamp frame surrounding the globe, and increases the amount of light for a considerable distance about the post. The "Boulevard" style has, in addition to the above, a second Reflector of a convex form, placed above the glass upon the chimney, which is secured to the top of the glass. This style of Lamp has been found by actual test during the space of nearly two years they have been in use in New York, to give fully one half more light than any other in use. The glass of these Lamps is made an elongated globular form, twelve diameter by twenty inches in height. The peculiarity of its form, and great thickness, enables it to withstand very rough usage. An improvement has recently been made for placing *street or other names* in a most conspicuous manner upon the Lamps.

He can refer to the Commission of Public Works, President of the Department of Parks, and any official of the city of New York, who has anything to do with the public lamps, as to the merits of these lamps. He will merely annex extracts of the written opinions given by the officers of some of the leading Gas-Light Companies and others. Further information will be given on application at the general office, 569 Broadway, New York City.

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Those who desire to participate in forming a Company to manufacture and handle this invention, or to purchase rights, will address as above. 123

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upper part of the furnace, where it entered in two small jets striking downward on the burning fuel. No sooner was the steam injected into the furnace than the sluggish, smoky fire sprang up into a clear, bright yellowish and intensely hot flame, filling the whole furnace with a loud roar. The man found he had not only secured a strong draft, but something much more important, a smokeless fire. As an experiment the apparatus was attached to the furnace of the *Herald* engine, which was converted from a neighborhood nuisance of smoke and soot into a smokeless flue.

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Cast Iron Gas and Water Pipe—Henry G. Nichols, 14 Platt street, New York..... 5
Cast Iron Gas and Water Pipe—Jno. McNeal & Sons, 117 Broadway, N. Y.....
Gas-Burners—C. Gefrorer, 259 Commerce st., Philadelphia, Pa..... 6
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Patent Conically Slotted Wood Trays—John L. Cheesman, 147 and 149 Avenue C., N. Y..... 1
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GAS COALS.

Despard Coal Co.—Parmelee & Bros., Agents, 32 Pine st., N. Y..... 6
Gas Coals—Bird, Perkins & Job, 86 South st., N. Y..... 1
Grahamite or Ritchie Mineral—27 South Charles street, Baltimore, Md..... 6
Ohio Gas Cannel—George Merryweather, 5½ Pine street, New York..... 3
The Newburg Orrel Coal Company—Chas. W. Hays, Agent in New York, Trinidad Building, 111 B'way, Room 7..... 3

FOUNDRIES.

Atlantic Dock Iron Works—Hoy, Kennedy & Co., Office 98 Liberty street, N. Y., P. O. Box 2348..... 1
Cast-Iron Pipes and Fittings—B. S. Benson, 52 East Monument street, Baltimore, Md..... 6
Continental Works—T. F. Rowland, Greenpoint..... 1
Camden Iron Works, Camden, N. J.—Jesse W. Starr & Sons
Gloucester Iron Works—J. P. Michellon, Sec., 6 North 7th street, Phila., Pa..... 1
Louisville Pipe Works—Dennis Long, cor. 9th and Water sts., Louisville, Ky..... 1
National Foundry and Pipe Works—Wm. Smith, Carroll, Pike, Smallman & Wilkins streets, Pittsburg, Pa..... 1
Pascal Iron Works—Morris, Taskar & Co., Philadelphia....1
Providence Steam and Gas Pipe Co., Providence, R. I.—H. A. Branch, Agent..... 1

WATER METERS, PUMPS, ETC.

Cast Iron Pipes for Water and Gas—Riley A. Brick, 89 White street, N. Y..... 6
Valves for Water, Steam and Gas—Ludlow Valve Man'g Co., 193 River street, Troy, N.Y..... 3
Water Pipes, etc.—S. Fulton & Co., 412 Walnut st., Phila.... 6

CLAY RETORT WORKS.

B. Kreisher, Clay Retorts, etc., 58 Goerck st., New York.... 1
Clay Retorts, Fire Brick, Tiles, etc.—Wilson & Gardner, Lockport, Westmoreland Co., Pa..... 1
Cheltenham Fire Brick and Clay Retort Works—Evens & Howard, 916 Market street, St. Louis, Mo..... 1
Jersey City Fire Brick Works—J. H. Gautier & Co., Greene Essex and Bergen sts., Morris Canal Basin, N. J..... 1
Laclede Fire Brick Works, 107 North Levee, St. Louis, Mo.. 1
Manhattan Clay Retort Works, 15th st., near Av. C, N. Y.. 1
Philadelphia Fire Brick Works, Vine and 23d sts., Phila.... 1
Retorts, Etc.—Geo. C. Hicks & Co., Baltimore Md..... 1

LAMPS, STOVES, PETROLEUM, ETC.

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AMERICAN

GAS SCREEN MAN'F'G COMPANY.

TO GAS-LIGHT COMPANIES.

Your attention is respectfully called to the GAS SCREEN now being manufactured by the American Gas Screen Manufacturing Company, under the patents granted to E. DUFFEE, and are pleased to submit the following points of their excellence and superiority over all other screens now in use.

The Screen is made with an oak frame, interlaced with split rattan, drawn through holes at regular intervals in the frame and cross-pieces, the edges of the frame being grooved to prevent abrasion.

The advantages of the screen are:

1st. The large purifying surface, the construction of the screen giving over three-fourths of the surface for the gas to penetrate the lime.

2d. On account of the free passage of the gas through the screen the pressure is reduced, thereby preventing the accumulating of carbon on the retorts.

3d. The saving of lime and labor, as the Screens are not liable to clog, and are easily cleaned.

4te Their cheapness and simplicity of construction.

5th. Their DURABILITY—they can be used longer than any other now used.

Testimonials.

PROVIDENCE, RHODE ISLAND, March 21st, 1872

E. DUFFEE, Esq., Agent, etc.

Dear Sir: The Trays manufactured by you for our West Station were put in use in September last, and have *given perfect satisfaction.*

The frames are well put together, and I see no reason why they will not last for a long time. The *very large amount of open space* in these Trays gives the gas an easy passage, and brings it into contact with the lime much better than when the space is so contracted, as is the case in most of the other Trays in use.

The pressure thrown upon the retorts by contracted passages is very great and were gauges used more frequently than they now are in many gas-works, this facat of having *open Trays* would become more apparent to mangers of gas works. The digerence in pressure at this station in passing the gas through your purifiers, is two-tenths (2-10) inches.

The amount of gas purified, per bushel of lime used to this date, is six thousand five hundred and fifty six (6,556) cubic feet.

Respectfully yonrs,
JAMES H. ARMINGTON. Supt.

BOSTON GAS-LIGHT CO., Dec. 1871.

Dear Sir: In answer to your inquiry how we like your Patent Tray for dry gas purifiers, I take pleasure in saying we have used them exclusive of all others, for the last three years. and think them far ahead of any yet offered. The surface being nearly three times that of any other Tray, and their lightness and durability perfectly satisfactory.

Yours respectfully,
A. M. GILES.

EDWARD DUFFEE, Esq.

EAST BOSTON, JUNE 15, 1871.

Gentlemen: We have used your Screens some five years. They give perfect satisfaction.

I consider them *by far the best Screen* for Dry Lime Purifiers have seen. Yours truly, A. M. NORTON, Supt.

CHELSEA, May 1, 1871.

Mr. E. DUFFEE.

We are using your Purifying Trays, and find them to be the *best of any* that I have used, and will *purify more gas with less pressure* than any tray that I know. I can fully recommend them, after four years trial, to any Gas Superintendent with perfect safety, as the *cheapest and best Tray made.*

Yours truly, JOHN ANDREW, Sup't.

DORCHESTER, March 3. 1870.

Mr. E. DUFFEE.

Dear Sir: We have had your Gas Trays in constant use for most one year and six months, and find them superior to any others we have ever used, both in point of economy and efficiency. Truly yours, W. B. BROOKS,
Agent Dorchester Gas-Light Co.

JAMAICA PLAINS, MASS., June 21, 1871.

EDWARD DUFFEE, ESQ.

Dear Sir; The Trays ordered by this company three years ago, are getting somewhat worn. I wish to say here that I consider your Trays to be superior to any yet invented, therefore please make us another set at the price named, to be like the sample shown in every way, and oblige Yours truly
JAMES F. ROGERS,
Sup't Jamaica Plains Gas-Light Co.

BROOKLINE, June 11, 1871.

E. DUFFEE, ESQ.

Dear Sir: You will please make a set of Gas Trays for this company as soon as convenient, at price named. In regard to the merits of the Tray, after having them in constant use for over two years, I will say that I consider them *superior to any Tray* manufactured in this country. Respectfully yours,
H. A. ALLYN,
Sup't Brookline Gas-Light Co.

BANGOR, August 2, 1870.

EDWARD DUFFEE, ESQ.

Dear Sir: Yours of the 20th ult. is received. In regard to your Gas Trays, I take pleasure in saying that they have been in use over two years, and have given perfect satisfaction and they are in good order at the present time; should have no hesitation in recommending them, believing they are the most durable and easiest kept in order of any with which I am acquainted. Respectfully yours,
W. H. PERRY, Sup't.

OFFICE OF THE SPRINGFIELD GAS-LIGHT CO.
SPRINGFIELD, MASS., Oct. 10, 1871.

MR. WARD,
President Hartford Gas-Light Co.

Dear Sir: I have been using Gas Screens made by the American Gas Screen Company, for nearly a year, and find them superior in every way to the wooden Screens made and formerly used by the Springfield Gas-Light Co. I can purify more gas with the same quantity of lime, there being more surface to the Screens; and I consider them more durable, and recommend them to your consideration.

Yours with great respect,
GEORGE DWIGHT.

ROXBURY, June 14, 1872.

EDW. DUFFEE, ESQ.

Dear Sir: In answer to your inquiry regarding your Patent Gas Screens, I am happy to be able to say, that after nearly three years constant use we are perfectly satisfied with them being able to purify over fifty per cent. more gas with them, than with any other Screen we have used.

Yours respectfully,
THOMAS J. PISHOU.

OFFICE DETROIT GAS-LIGHT CO.,
DETROIT, MICH., April 22, 1872.

AMERICAN GAS SCREEN MANUFACTURING CO., HAVERHILL.

Gentlemen: The Screens bought of you work far better than any we have ever used. As a proof, we have with the same quantity of lime purified *twenty per cent.* more gas with your Screens than with any others, and the work well done. The workmen are also better pleased with them—they being light and handy to work. They also relieve the pressure very much upon the retorts, and I cheerfully give you my experience. Yours truly,
P. E. DEMILL. Secretary.

We give a list of some Gas-Light Companies using them.

Providence, R. I. Gas-Light Co.. Boston, Mass. Gas-Light Co.: East Boston, Mass., Gas-Light Co.; South Boston, Mass., Gas-Light Co.; Springfield, Mass., Gas-Light Co.; New Bedford, Mass., Gas-Light Co.; Manchester, N. H., Gas-Light Co.; Reading, Penn., Gas-Light Co.; Biddeford, Me., Gas-Light Co.; Hartford, Conn., Gas-Light Co.; New Haven, Conn., Gas-Light Co.; Cincinnati, Ohio.; Gas-Light Co.: San Francisco, Cal., Gas-Light Co.: Albany, N. Y., Gas-Light Co.; Sacramento, Cal.; St. Joseph, Mo., Gas-Light Co.; Leavenworth, Kansas, Gas-Light Co.; Macon, Ga., Gas-Light Co.; Roxbury, Mass., Gas-Light Co.; Lansinghburg, N. Y., Gas-Light Co.; Bridgeport, Conn., Gas-Light Co.; Stamford, Conn., Gas-Light Co.; Poughkeepsie, N. Y., Gas-Light Co; Scranton, Penn., Gas-Light Co.; Lewiston, Me., Gas-Light Co., and one hundred others.

Address **A. P. JAQUES, Treas.,**
Amer. Gas Screen Man'f'g Co., Haverhill, Mass

DENNIS LONG & CO.,

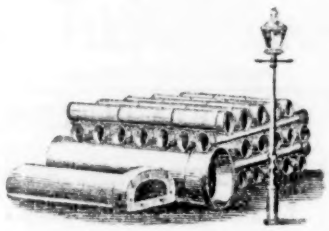
Union Pipe Works,

Louisville Pipe Foundry,

AND

Union Foundry and Machine Shops,

LOUISVILLE, KY.



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Cast Iron Gas and Water Pipe,

All Pipe cast vertically in dry sand.

2 inch Pipes in 8 feet lengths. 3 inch to 60 inch cast in 12 feet lengths.

RETORTS AND MOUTH PIECES, LAMP POSTS, CONDENSING PIPE, HYDRAULIC MAINS, PURIFIERS, DRIPS, ELBOWS, T'S, CROSSES, SLEEVES, VALVES, &c., &c.

GAS-HOLDERS.

And every description of work necessary for Gas or Water Companies.

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ARCHITECT AND GENERAL GAS ENGINEER,

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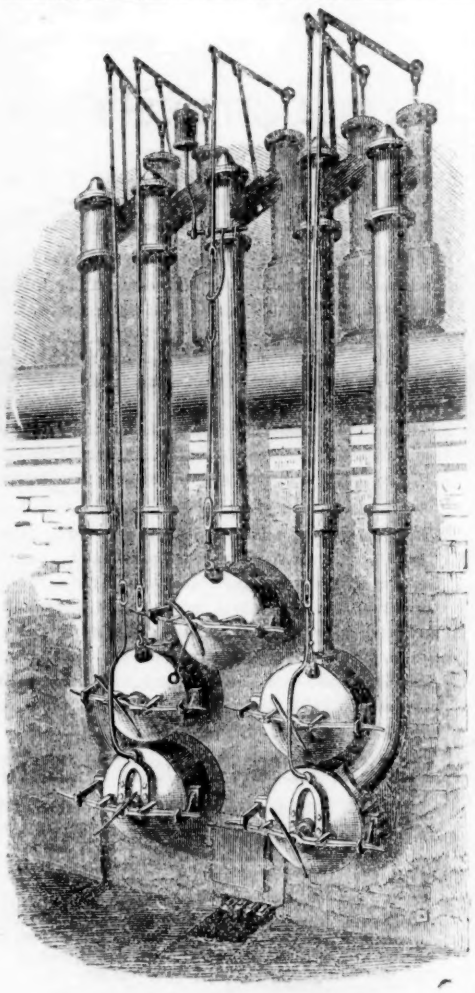
WILLIAM FARMER may be consulted upon all matters connected with the construction of GAS WORKS and other buildings. Will furnish General and Detail Drawings, Specifications and Estimates for Gas Works of any capacity, Retort Settings, Condensers, Washers, Exhausters, Purifiers, Holders, Coal Hoisting Apparatus, Iron Roofs, and every description of Machinery required in the Manufacturing of Gas.

PATENTEE OF THE FOLLOWING INVENTIONS:

Exhausters for Gas and Foul Lime Ventilation,
Dumping Barrows for Coal, Coke and Lime,
Blowers for Forgers,
Pumps for Water, &c., &c.

REFERENCES:

CHAS. ROOME, President Manhattan Gas-Light Company, N. Y.
SAMUEL DOWN, President American Meter Company, N. Y.
C. VANDERVOORT SMITH, Engineer Manhattan Gas-Light Company, N. Y.
CHARLES MOWTON, Engineer New York Gas-Light Company, N. Y.
SAMUEL P. PARHAM, Engineer Mutual Gas-Light Company, N. Y.
Prof. HENRY WURTZ, Editor AMERICAN GAS-LIGHT JOURNAL.
HENRY J. DAVISON, Engineer, 77 Liberty Street, N. Y.
HERRING & FLOYD, Oregon Iron Foundry, 738 Greenwich Street, N. Y.
FREDERICK SABBATON, Engineer Troy Gas-Light Company, Troy, N. Y.
Col. WHITE, Engineer People's Gas-Light Company, Williamsburgh, N. Y.
GEORGE W. PARSONS, Sup't and Eng'r. Rochester Gas-Light Co., Rochester, N. Y.
GEORGE W. EDGE, Engineer, Jersey City Gas-Light Co., Jersey City, N. J.
J. H. GAUTIER & Co., Fire Brick Works, Jersey City, N. J.
Professor SILLIMAN, New Haven, Conn.
JOHN HARRISON, Engineer People's Gas-Light Company, Baltimore, Md.
CHARLES FABEN, Superintendent and Engineer Toledo Gas-Light Co., Toledo, O.
PETER F. BURTIS, Supt. and Engineer, Chicago Gas-Light Co., Chicago, Ill.
JAMES R. SMEDBERG, Consulting Engineer, San Francisco Gas-Light Co., Cal. [254-



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ADJUSTABLE AUTOMATIC DIP-SEAL,
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Improved Retort Lids.

The Seal closes automatically, when the retort-lid is removed, and is broken by replacing the lid. No mistake can possibly be made. The rods are adjustable in a moment to any contingency. The new attachments are adaptable to any Works. Cost only that of rough castings. No lute used, and no leakage at lids. Half the number of lids only needed. Capacity of mains greatly increased. In new Works no mains. No carbon in retorts, seldom in stand-pipes. Addre

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I am now prepared to place in the market, through my agencies as below, a regular and unlimited supply of this valuable Cannel, for gas purposes. A recent analysis, by Prof. WURTZ, Editor of this Journal, at the Laboratories of the NEW YORK GAS-LIGHT COMPANY, gave 47½ per cent of Volatile Matter and 45 bushels to the ton of a fair quality of coke. The yield of gas was at the rate of 9,500 feet per ton of about 27 candle power. It is not highly sulphurous, can be purified by Lime, and the ash from the coke does not clinker.

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Agents for G. W. EDGE'S PROCESS for removing Carbon from Retorts.

Post Office Box 2,348. Office 98 Liberty st

CAUTION.

SEVERAL CONTRIVANCES HAVING BEEN DEVISED for the purpose of dispensing with the dip-pipe seal, by means of a valve, or cut-off, between the retort and the hydraulic main, in gas works, since this method of making gas was introduced by the AMERICAN COAL GAS LIGHT IMPROVEMENT COMPANY, all of which are infringements upon Letters Patent, numbered 95,459—116,450—and 119,135, owned by said Company. All Gas-Light Companies are cautioned against the use, without license or authority from the undersigned., of said devices.

The Am. Coal Gas Light Improvement Co.
JOHN H. BLAKE, President.
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Our experience in the manufacture of Pipe for a great many years, has enabled us in rebuilding to practically apply Machinery and Fixtures of the very best character, to insure *good work.*

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MANUFACTURERS OF SINGLE AND TELESCOPIC
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Cast and Wrought Iron Work
Used in the Erection of Gas and Coal Oil Works.

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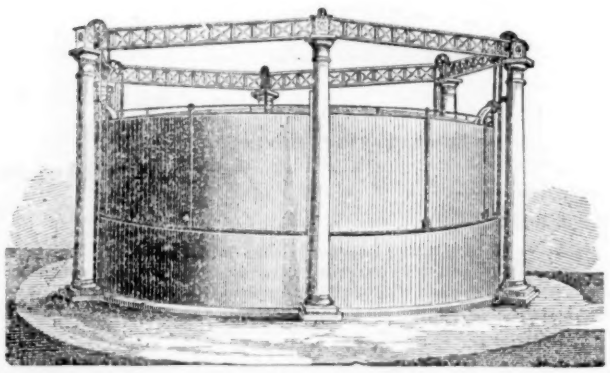

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Particular Attention paid to Alterations and Repairs.

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Estimates furnished of the cost of Works, and cost to Manufacture Gas in any Locality.

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Purifier Covers,

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W. F. Warner, Oswego Gas Co., N. Y.
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PIPE CAST VERTICAL.

1½ to 48 inches diameter.

Cast Iron Flange Heating and Steam Pipe.

STOP VALVES FOR WATER OR GAS, ALL SIZES.

Fire Hydrants,

GAS HOLDERS,

TELESCOPIC OR SINGLE.

☞ Castings and Wrought Iron Work of all kinds for Gas Works. 253-6m

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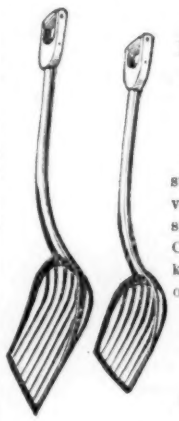
Coke and Coal
SCREENING SHOVELS.



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Perfect in their operation. Very strong, and from their great durability vastly more economical than any substitute. Refer to all the principal Gas Companies in the country, who acknowledge them as the "ne plus ultra" of Coke Screening Shovels.

Orders addressed only to

O. R. BUTLER,
Sole Agent.
No. 96 Maiden Lane, N. Y.

CAUTION.

Gas Companies, and all parties using Screening Shovels, are cautioned against the purchasing (or manufacturing) of any other than myself, or my agents, COKE SCREENING SHOVELS, made either in whole, or in part, of **Malleable Iron,** as such is decided to be an infringement of Butler's Patent of June 4, 1872.

O. R. BUTLER,
96 Maiden Lane, N. Y.

OFFICE OF

THE GAS-LIGHT CO. OF AMERICA,

C. K. GARRISON, President.
E. W. McGINNIS, Secretary and Treasurer.
JOHN P. KENNEDY, Chief Engineer.
LEONARD D. GALE, Consulting Chemist.

GENTLEMEN: We beg leave to inform you, that we have purchased the Patent process for making ILLUMINATING GAS from PETROLEUM and its products, known as the

Gale and Rand Patents,

and we are now prepared to treat with you for the use of said process by your Company.

We are also prepared to contract for putting said process into successful operation in your works, furnishing all the necessary plans, materials, and workmen for that purpose.

We do not deem it necessary to enter upon a detailed description, here, of the processes above referred to, deeming it sufficient to state, to secure your interest and investigation, that they have been in successful operation, for months, in a number of Gas-Light Works in the United States, and are now being introduced in the works of the Mutual Gas-Light Company, of New York City; the Citizens' Gas-Light Company, of Brooklyn; the New Orleans, San Francisco, and very many other Gas-Light Companies throughout the country.

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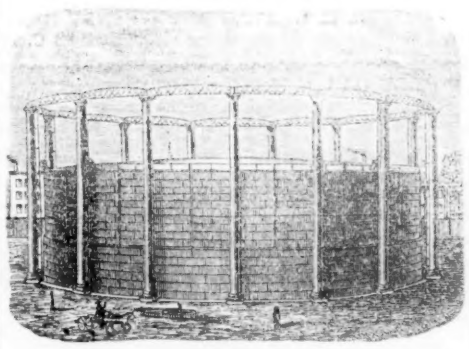

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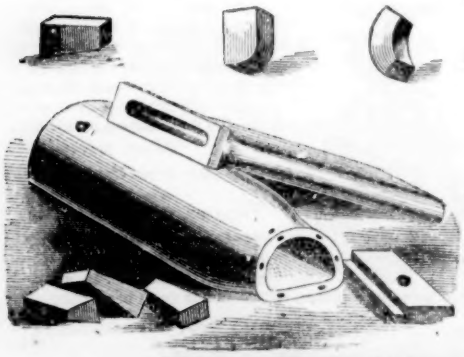

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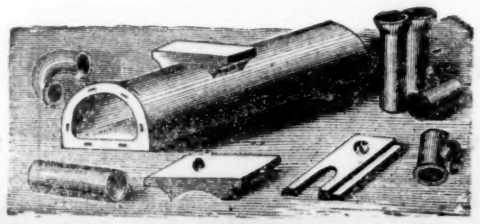

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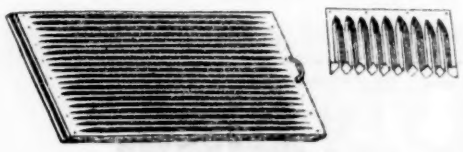

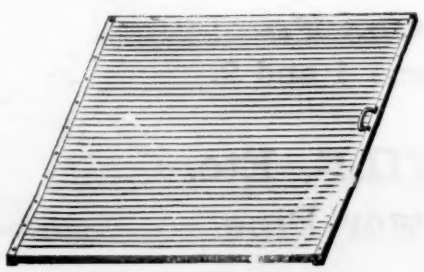

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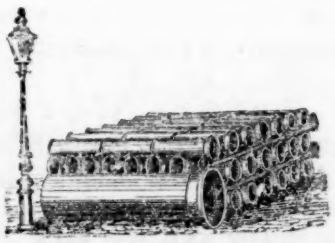

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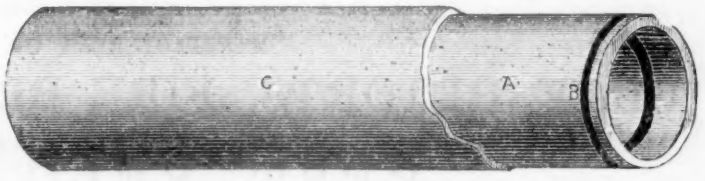

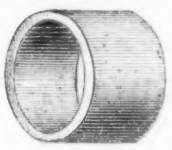

FIG. 2.

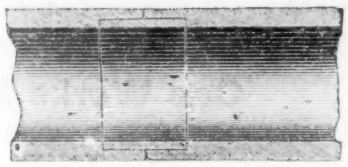

FIG. 3.

A—Cylinder of Wood. B—Band of Iron. C—Coating of Hydraulic or Asphaltum Cement.

FIG. 2.—Thimble for Connection. FIG. 3.—Horizontal Section and Connection.

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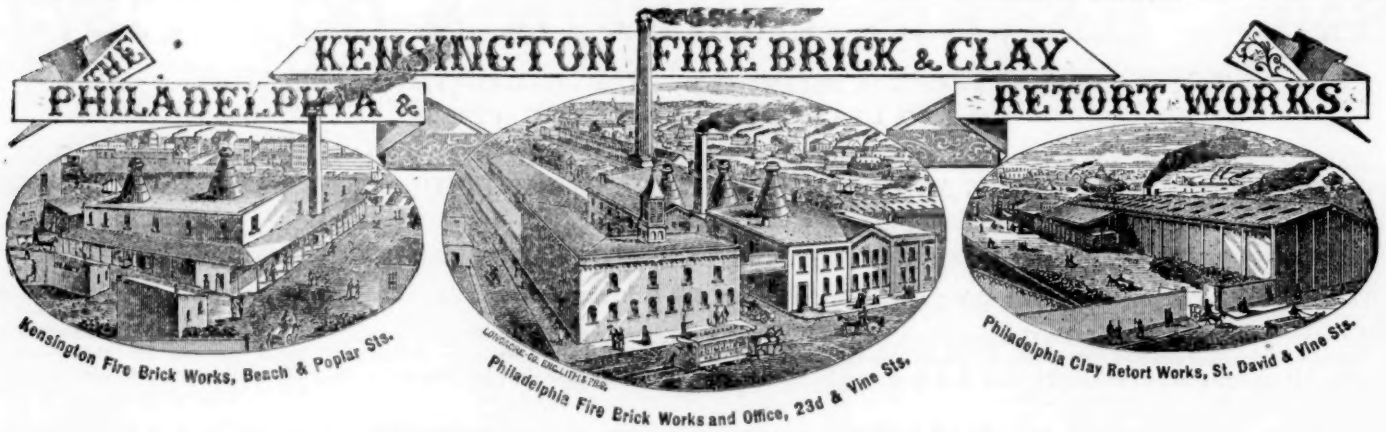
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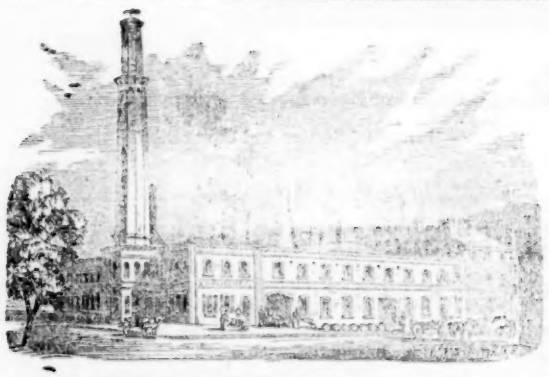

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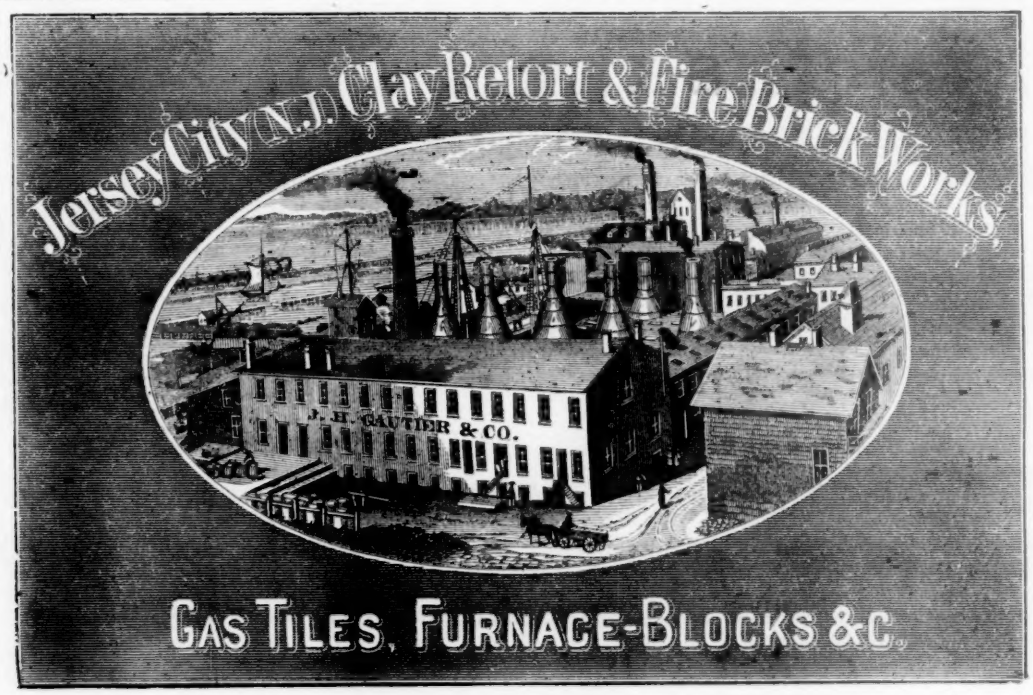

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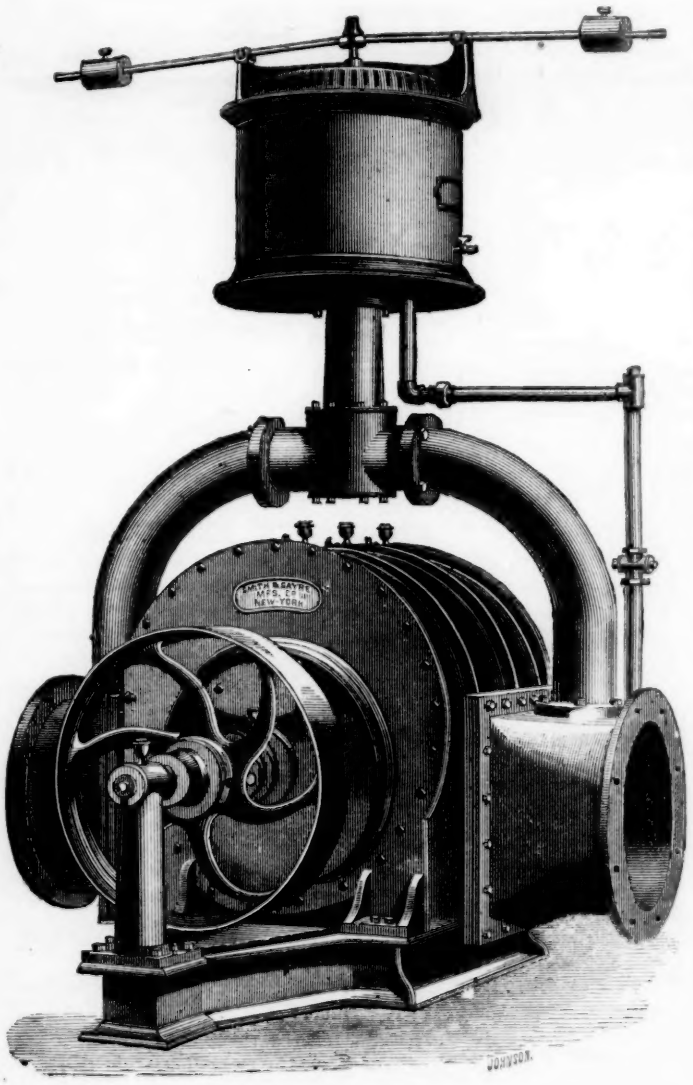

They are made to pass from 4,000 to 250,000 cubic feet of gas per hour; will increase the production and illuminating power of the gas, and add very much to the durability of the retorts, either clay or iron. The Compensator obviates entirely the necessity of water-joints, is compact, durable, cleanly, not liable to get out of order, self-acting, quiet, and certain in its operation.

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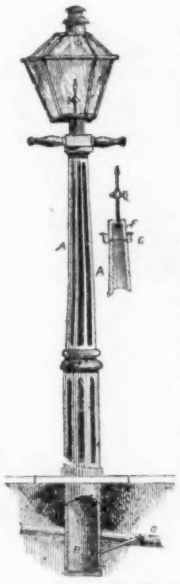

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Yours truly,
LUCAS FLATTERY
Sec'y Wooster Gas-Light Co.

Address the Patentee,

J. W. GRAHAM,
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P. Munzinger's Improved Centre Valve.

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Fig. 1 represents a Dry Centre Valve complete for four Purifiers. It is also arranged so as it can be used for one, two, or three Purifiers.

Fig. 2 represents a section through.

The construction of the Valve is such that one Purifier is always shut off for cleaning or repairing.

The claim in this improvement is the concentric inlet and outlet, drip pipes, rotary valve, and the covered radial joints.

The joints being covered prevent the tar and ammoniacal liquor, dropped by the gas, from rusting the joints, which happens in all other Valves where the joints are not covered, thereby making a leaky Valve.

This Valve has been in use for three years, with perfect satisfaction.

Fig. 1.

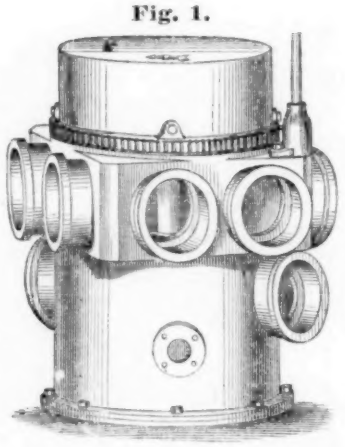
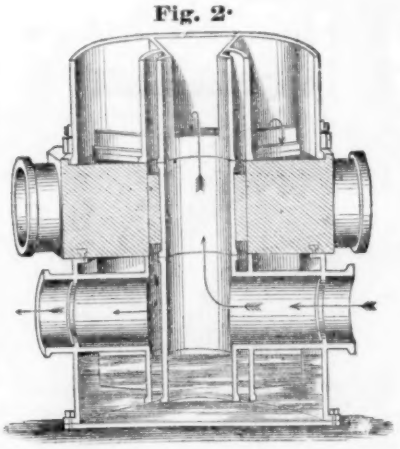


Fig. 2.



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Trenton Gas-Light Company, N. J., 12 in.
New Britain Gas-Light Company, Conn. 10 in.
Westchester Gas-Light Company, N. Y., 10 in.
St. Paul Gas-Light Company, Minn., 10 in.
Schenectady Gas-Light Company, N. Y., 10 in.
Rahway Gas-Light Company, N. J., 8 in.
Atlanta Gas-Light Company, Georgia, 8 in.
Altoona Gas-Light Company, Pa., 8 in.
Harrisburg Gas-Light Company. Pa., 8 in. and 6 in.
East Newark Gas-Light Company, N. J., 6 in.
Cumberland Gas-Light Company, Mo,, 8 in.
Augusta Gas-Light Company, Ga., 6 in.
Princeton Gas-Light Company, N. J., 6 in.
Lockhaven Gas-Light Company, Pa., 6 in.
Hagerstown Gas-Light Company, Md., 6 in.
Coatesville Gas-Light Company, Pa., 6 in.
Uniontown Gas-Light Company, Pa., 6 in.
Wooster Gas-Light Company, Ohio, 6 in.
Pontiac Gas-Light Company, Mich., 6 in.
Battle Creek Gas-Light Company, Mich., 6 in.
Lawrence Gas-Light Company, Kansas, 6 in.
Indiana Gas-Light Company, Pa., 8 in.
Washington Gas-Light Company, Pa., 6 in.
Medina Gas-Light Company, N. Y., 6 in.
And many other Gas Companies.